FRAMING COMPLEXITY: TEACHERS AND STUDENTS USE OF TECHNOLOGY IN ALASKA ONE TO ONE LAPTOP LEARNING ENVIRONMENTS

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A

DISSERTATION

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By

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Abstract

The topic for this dissertation is to investigate perceptions within the implementation of established one to one laptop learning programs in Alaska high schools. A primary purpose is to gain understanding of teacher and student perception of their technology use levels by establishing a level of adoption. A secondary purpose is to gain understanding of teacher perceptions regarding concerns and implementation concepts. The theoretical framework for this study used a concurrent mixed methods approach, beginning with a quantitative broad survey with supporting qualitative open-ended questions. The sample used for this study includes public high school teachers and students, who are part of a one-to-one laptop program in thirteen schools districts across Alaska.

Analysis of frequencies of technology use and levels of proficiency for both students and teachers were made in areas of personal and classroom use. Teacher professional practice was also analyzed with an emphasis on professional development. Statistical analysis included analysis of variance of demographic measures and classroom use, correlation and regression of teachers' levels of proficiency. Findings indicated a mature implementation of one to one programs throughout the teacher population sample with teachers reporting high stages of concern and moderate levels of technology use focused on the students' use of technology for learning. Implementation recommendations indicated by this study include the use of a framework to measure program progress and to gather teacher voices through the life of a project, clear communication of program goals, and a professional development model suited toward teachers' needs. This study will provide a baseline of knowledge for future studies in Alaska.

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Preface

Biographical Information

Robert Whicker was raised in the small farming community of Ault, Colorado. After graduating from the University of Northern Colorado with BA/BS degrees in Physical Education and Business Administration, he and his wife, Betsy, went to Naknek, Alaska to teach and coach for a year that turned into eight. During that time, a daughter Sarah, and son, Cale was born. After a move back to Colorado, and ultimately to the Rio Grande Valley of Texas, Robert obtained a M.Ed. in Exercise Science: Physiological Psychology from Colorado State University, and a School Administration Principal certificate from University of Texas, Pan American.

Alaskan education drew the Whicker family back to to the state in the late 1980's to Chignik Bay School, where Robert worked as a principal, followed by a principalship in Kake City School District, Craig School District, and Sitka School District. The Whickers returned to Craig School District and then Ketchikan School District as Robert served as charter school director, and home school support program director. Technology, entrepreneurial efforts within public education, and community partnerships were areas of focus in every one of his workplace environments.

Robert served with the Denali Borough School District as superintendent of schools, where the district implemented a one to one laptop program for grades 6 – 12. Betsy and Robert retired from Alaska public education in 2005 when Apple, Inc. hired Robert to serve as an Education Business Executive for the Pacific Northwest serving five states including Alaska. This experience of working with school districts in large-scale technology deployments was valuable in learning from industry leaders in areas of technology integration, large-scale implementation models, professional development and action planning. It also helped to establish connections with over 6000 educators per year in planning sessions, conferences and various presentations.

Robert left Apple in 2011 to assume the directorship of the Consortium for Digital Learning (CDL) as it moved into a new model of service and infrastructural support for Alaska one to one laptop programs, many of them originating from the CDL model.

Acknowledgements

When I began this effort toward my Ph.D., I had to be talked into it. Why would one start such a program at age 55 with a career that was so rich and full? My wife, Betsy, convinced me that the circumstances made such a move seem reasonable. My employer would pay for the courses, my job required travel on a regular basis to places such as the ones I would be studying, the study would add additional knowledge to my job of consulting with school districts about technology integration, and the degree would give me more professional credibility. It sounded reasonable.

Little did I know that I would be convinced to accept a position in Alaska to direct the Consortium for Digital Learning to restart the Consortium in a new iteration requiring an enormous effort. The move was a very positive one for our family; however, I lost all support for funding of my degree a year and a half into my studies. The primary reason for me to complete this degree, and its final requirement of this dissertation, was to acknowledge the love, patience, and active support of my wife. Betsy is the love of my life, and has supported me in every endeavor. She is a role model to all of our family in uncompromising faith, unconditional love, and unwavering commitment. The effort and sacrifice she has made for me to finish this dissertation is simply amazing. Only her voice could spur me on to do what needed to be done.

The other primary motivation for me to complete this degree was to follow through on the statements my actions communicated to my children, Sarah Negri and Cale Whicker. Faithfully following words with action is something my children had grown up with and is a lasting family value from my belated parents, M.E. and Donna Whicker, and my parents-in-law, Melvin and Margaret Fauchald, to whom I owe everything. They inspired me to have faith in God, listen to Him closely, and act with conviction.

The loyalty, support, and teamwork of my cohort, Pam Lloyd, Mark Standley and Larry LeDoux is something that is rare in the world, and was a major force in helping me to believe this accomplishment was possible. They will always be my special friends. The same feeling of appreciation is present for Dr. John Monahan, my committee chair, who

has always treated me as a special friend and colleague. His self-sacrifice to others and his efforts to enable our cohort to achieve this accomplishment is something I aspire to. Thanks go out to my committee, Dr. Jean Richey, Dr. Roy Roehl, Dr. Norm Eck, and Dr. Robert Crumley. Their support and encouragement was always appreciated.

There is no way in the world that I could have competed this dissertation without Dr. Barbara Adams, our professor for the entire three years, and a very special person. She has gone beyond the extra mile to help, and encourage me throughout this process. Her knowledge and common sense kept me moving forward at times when I did not think it was possible. I am forever grateful.

Chapter 1: Introduction

The topic for this dissertation is to investigate perceptions within the implementation of established one to one laptop learning programs in Alaska high schools. It attempts to primarily gain understanding of teacher and student perception of their technology use levels within this context by establishing a level of adoption (LoA). A second purpose is to gain understanding of teacher perceptions regarding concerns and implementation concepts. Gaining knowledge through this study of perceptions of technology use by teachers and students will help to establish a baseline of information from which to establish future studies. Alaska's multi-district model of implementation of one to one laptop programs is in its sixth year and no studies to date have investigated these topics.

Due to the exploratory nature of this study, a mixed methods approach was used to ascertain findings through an inquiry-based, descriptive analysis of both teachers' and students' perceptions of the personal and classroom use of technology. Conclusions are drawn across the demographics of both samples regarding their reported uses.

Indices of teachers' technology use and descriptive roles they play when using technology were established in the areas of personal use, professional practice, and classroom use following the work of Lemke, (2009). The relationships of independent variables of the teacher demographic data in nine categories were analyzed in relationship to the indices.

In addition, teacher concerns of technology integration were measured through the Concerns Based Adoption Model, an established framework of innovation adoption and the adoption of technology through a modification of the work of Dalgarno (2009). Teacher perceptions of their one to one laptop program implementation were also investigated.

1.1 Theoretical framework

The theoretical framework of this study is to provide information and understanding of particular aspects of one to one laptop programs in Alaska.

The multifaceted nature of school and the intricacies of vision, design, and implementation of one to one laptop programs, lend to differing measures of success. One of the measures of success of laptop programs is the use and application of the technology by teachers to engage students in learning activities, and the results or outcomes of those uses.

Teachers can be gatekeepers to learning with technology. The characteristics of technology use in their personal and professional lives, attitudes, and beliefs toward change and pedagogy may be related to levels of use of technology in the classroom (Bebell & Kay, 2010).

Frameworks of change and levels of technology adoption with predictable progress have been established to help understand stages of development that large reform efforts bring with them (Newhouse, 2001). Many factors influence the outcomes of a one to one project and the perception of its success. By using a framework of change to determine teacher levels of technology adoption in Alaska one to one laptop programs, a baseline of technology frequency of use, expertise, and teacher concerns can guide decisions toward progress of current and future initiatives.

Students growing up in a technological world are by nature, more comfortable with technology than teachers. Study of students' and teachers' technology use personally and in school, where there is access for each individual, can provide insight to develop these learning environments in productive ways. The voice of students and teachers regarding their technology use in and out of school may help to understand alignment of teacher efforts and practice. Therefore, the focus of this study will be on what teachers and students are doing with technology, their degree of expertise, concerns teachers have regarding implementation, and the levels of use they report after being in a one to one implementation for some years.

1.2 Overview of methodology

The results of this mixed-method study come primarily from a descriptive analysis of the quantitative data of a cross-sectional online survey for each population group, one for teachers and one for students. In addition, the concurrent research design yielded qualitative data gained from open-ended questions that informs and supports the heart of the quantitative survey completed by the teacher group.

The surveys were constructed by modifying surveys from two previous research studies, and were developed through a team effort of the Tech Cohort. Each survey contained questions specific to the research of cohort members and their individual research problem. In addition, each member of the cohort also contributed a question pertaining to his/her individual research for the focus groups used in a grounded theory study in four schools of one cohort member (Standley, 2012). Each member of the cohort drew from the dataset to answer his/her individual research questions.

A pragmatic approach enables "a combination of different world views, different assumptions, and different forms of data collection and analysis" (Creswell, 2009, p. 11). A post-positivist approach of reductionism was used to help identify researcher bias and use statistical analysis between variables when establishing indices of technology LoA.

The rationale for incorporating surveys in a study is to provide a method of description of the population through the study of a sample of that population (Creswell, 2009). The quantitative online surveys for each sample group in this study were a method to compare self-reported uses of students and teachers in various areas of technology use within one to one laptop programs in a consistent manner. Themes generated from open-ended questions of the survey were used to gain deeper understanding of specific areas of interest within the quantitative results.

A multi-stage sampling procedure was used by dividing each survey into distinct sections and using a combination of single item questions, Likert-scale items, and open-ended questions. Of the twenty-one school districts identified as having high schools with one to one laptop programs, thirteen districts met the established population definition described in section 1.4, and granted permission for the research. With support from the school administrations, each survey was made available to all high school students and high school teachers in the schools of those thirteen districts with one to one programs.

1.2.1 Statement of the problem.

Millions of dollars are spent on technology each year in Alaska to provide technology for students, as well as technology for infrastructural and administrative needs in our schools. One to one laptop programs are continuing to grow in K12 schools since the first sustained efforts were made in individual school districts in the early 2000's. It has been reported that 10% of Alaska students currently spend their classroom time in such a program, ranking Alaska fifteenth in the nation in a national study where schools reported having computing devices for every student (Greaves, Hayes, Wilson, Gielniak, & Peterson, 2009). As more educational leaders consider the most effective use of technology in our schools, understanding how teachers and students use technology in our state is necessary.

Many of the students and teachers in one to one laptop programs participated in a multi-district project sponsored by the Association of Alaska School Board's (AASB) Consortium for Digital Learning (CDL) to initiate such programs. AASB established the CDL with two legislative appropriations, the first in 2006 totaling 5 million dollars and again in 2008 for 2.5 million dollars to establish and expand laptop-learning programs in Alaska. Over 100 schools in 28 of the 53 Alaska school districts participated in the programs across grade levels by providing a laptop per student and teacher within a wireless network (Nelson, 2006). Most of these projects were in rural/bush Alaska in smaller school districts. Several other school districts initiated one to one laptop programs outside the funding of the CDL and have since joined the Consortium.

Almost all of the one to one programs started in the state of Alaska followed the "complete solution" model, proposed by the CDL. This complete solution followed recommendations from Apple, Inc., based upon its experience in implementation of one to one programs across the country, and the research and evaluations of its large-scale implementations in Maine and Virginia. The solution set included an analysis of the wireless network and electrical capabilities of the school, a common hardware platform, a common software package of productivity and creative software, a prescribed package of professional development and technical services, the development of an in-state repair depot to speed return of damaged equipment, and a reserve of spare computers per school to minimize downtime. A "loanership" policy for at home use by students was strongly recommended.

To date, there are three known studies concerning Alaska's one to one projects (Edwin, Hirshberg, & Hill, 2009; Ohler, 2009, 2011). All three studied a small sample of targeted one to one projects and will be discussed further in the review of literature.

The lack of research in Alaska regarding one to one laptop programs is due to a variety of reasons including (a) loosely defined goals for the project, (b) evaluation left to the district, and (c) a lack of useable baseline data.

One of the complexities of one to one initiatives is the difficulty for educational leaders to define specific, meaningful measures of success within the goals established for their projects (Lemke & Coughlin, 2006). In a review and analysis of one to one learning, Lemke categorized the reasons for implementation of such programs into four areas: (a) improving student achievement, (b) advancing digital equity, (c) enhancing teaching and learning, and (d) strengthening economic development. In addition to the reasons cited in Lemke & Coughlin (2006), AASB's reasons for implementation were to provide students with globally competitive skills regardless of the geography where they live, extend the learning day, and connect parents more closely to their childrens' educational process (Rose, 2006).

Evaluation of one to one programs in Alaska has been the responsibility of the individual districts. Most of the small districts are ill equipped to conduct substantial research, especially with their limited resources amidst all of the other day-to-day responsibilities of the delivery of education. Evaluation expertise, time available for staff, and limited resources, such as funds and evaluation instruments, are all cited as being hindrances to conducting research for small schools (Sanders, 1988). The transient nature of students, teachers and administrators in our state also brings an added layer of complexity to research if it is not anticipated.

Due to the lack of established research protocol from the beginning of most projects, baseline data outside of group test scores has been lacking in Alaska one to one projects. Many projects were initiated in a very aggressive timeline making the window for the collection of pre-data difficult, and any comparison to post-data regarding the implementations complicated. This lack of baseline data in turn created issues with identification of the population of students within the one to one program over time.

These missed opportunities to collect accurate data made specific analysis or comparisons of cohorts of students difficult, if not impossible. Research attempts to establish these populations of cohorts over broad categories made inclusion of students that did not participate in the program possible (Edwin et al., 2009).

The general lack of knowledge of the aspects of one to one laptop programs has led to a poor understanding of the role of the teacher and their concerns of the implementation process. This information concerning one to one programs is important for school leaders as they grapple with how to provide relevant education for the 21st century, create systems of support in schools in areas of critical components of a one to one laptop program, create policies that align to the goals established for their programs, and employ and grow employees to learn how to use the technology to teach and inspire students when a tool per user environment is present.

1.3 Backdrop for Study

Perceptions gained by serving as a school superintendent in a district that considered its one to one laptop program a success enabled this researcher to see the power of placing technology in a one to one laptop model to expand learning opportunities and elevate learning outcomes as documented by Via, (2011). Personal experience as an educational development executive with Apple, Inc., from 2005 until 2011 for five states, and frequently travelling 13 western states of the United States, provided engagement with schools implementing many types of technology projects. Some of these schools pursued one to one laptop programs in some fashion, enabling a broad perspective on issues involved in implementation of these projects.

During these projects, it became apparent that the incongruence of what may be actually happening at basic levels might often be over shadowed by the complexity of the community of school itself, especially when large-scale school reform is happening at the same time. These complexities sometimes obscured the intangible benefits of the retooling and reengineering of those educational systems with current technologies to assist in the learning process. Many times, the voices of teachers and students were barely audible.

Through personal involvement with one to one schools, common aspects of complexity of the planning effort and implementation at the school and district level became evident. In several instances in district implementations, there were no significant efforts at substantive evaluation of the program within a research design due to the demands and expense of the research. Often, the focus of the initiative was the technology rather than the pedagogical uses of technology in learning. This corroborates a predominate view that access to technology in schools will lead to an adequate implementation of classrooms being filled with technology, without having teachers trained to properly use it as a central core to instruction (Putman, 2007).

Within the cadre of one to one laptop learning schools this researcher encountered, nearly all had anecdotal evidence from teachers, students and parent groups of perceiving significant value of the programs and its support of the schools efforts. In Alaska, a qualitative study of one to one projects in a sampling of school districts found evidence of a similar perceived value (Ohler, 2011).

As with any project which has large-scale significant implications on teaching and learning, the process of change is a primary consideration. There are many complexities of implementing high access technology in schools. In Alaska, unique challenges are presented when considering this type of implementation. The majority of the approximate one hundred schools in Alaska currently pursuing some manner of one to one laptop learning programs are in rural or bush Alaska in small schools. Most implementations are in high schools with some middle schools and a few elementary schools. Isolation due to geography, limited transportation options, and lack of economy bring a set of challenges to any change process that is undertaken, including one to one computing (Rose, 2011).

Due to the complexity of Alaska education, the implementation of one to one laptop programs, and the change process itself, a frame for the study is needed. A variety of parameters and controls are necessary when studying one to one learning environments. Since the majority of one to one implementations in Alaska are high schools, these programs were chosen as the focus of this study. Another parameter was to develop a working definition of a one to one laptop program that would help meet the questions of this study and the Tech Cohort.

Within the schools of this study, the acknowledgement of critical components of support and systems to address them in support of implementation efforts were known to be present. This is because the set of standards identified by the CDL has become common among districts pursuing a one to one program.

The definition of a one to one laptop program used in this study is a model of implementation that includes (a) students and teachers having access to laptops anytime, anywhere, in and out of school, (b) access to a wireless infrastructure, (c) the use of the laptops included in the curriculum as tools of learning, and (d) a professional development model including technology integration in the learning process. In order to answer questions regarding home use of computers by students and teacher practice as a result, only high schools that had pursued the policy of at-home use of a school issued laptop at some time during the project were included.

The schools meeting such definition and included in this study are indicated in Figure 1.

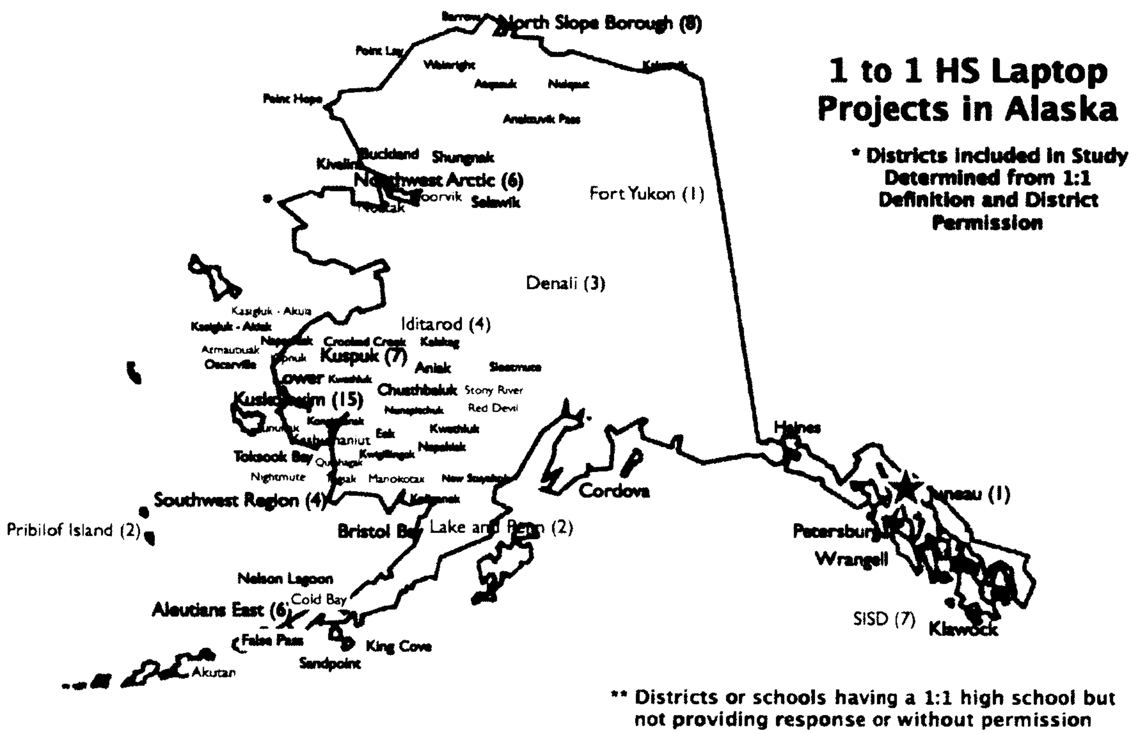

Figure 1. High School One to One Projects in Alaska

1.4 Significance of Study

Technology has been identified as an important component of educational reform in the nation and in Alaska (Fletcher, 2009; Rose, 2006). In this study, information regarding the relationships between teacher demographic information, tenure, and amount of professional development to teachers reported use of technology are studied to provide educational leaders information regarding staffing and professional development programs. Information gained from this study regarding the alignment of technology uses by students and teachers can provide understanding to better utilize technology in an effective manner. More specific data that would lead to student impacts as a result of teacher directed technology use within the classroom, and to understand relationships between student and teacher use in various aspects of their lives, would help to be able to define specific goals for one to one technology projects. Frameworks that measure innovation as a measure of technology adoption were investigated in relationship to levels of technology use so that policymakers and future architects of such one to one initiatives may have better measures to design their program, address concerns, and understand its progress. Overall findings should provide a baseline for guidance to others when implementing a one to one learning program in Alaska, particularly at the high school level in the development of policy and procedure of systems of support. Information on the assessment of technology levels of teachers could provide aid in the development of a differentiated professional development model and hiring practices in one to one laptop programs.

1.5 Purpose of the Study

The purpose of this study is to provide baseline data and insight on how technology is used by both students and teachers to determine levels of technology adoption in learning and teaching in Alaska one to one initiatives.

1.6 Research Questions

The overarching questions of this research are, "What are the levels of adoption (LoA) of technology of students and teachers, and the skills, attitudes, and assumed roles of teachers inside and outside the educational setting within existing Alaska one to one high school laptop programs?"

Additional questions to explore that support/enlighten the main research questions are:

1. How do teacher perceptions of their technology use in the classroom vary based on teacher demographics?
2. Do teachers' perceived levels of uses in their personal and/or professional practice lives relate to levels of technology uses in the classroom?
3. What is the level of adoption of the one to one laptop program as measured by the framework of the adoption of innovation, the Concerns Based Adoption Model (Hall & Hord, 2011)?
4. How do students and teachers use technology differ in personal use and classroom use?
5. What are perceptions of teachers regarding the implementation of

technology in one to one laptop programs?

1.7 Summary

This study attempts to bring light to questions that have been suggested for further study within previous research studies. A call for an examination of technology use and pedagogy as a necessary step in the assessment of progress in high access laptop learning environments has been suggested (Russell, O'Brien, Bebell, & O'Dwyer, 2003b). While there is a temptation to focus on the impact of technology on student achievement in a large-scale implementation of a one to one project, it has been suggested that impacts on learning that teacher and student technology uses within context should be a first consideration (Bebell, Russell, & O'Dwyer, 2004). The analysis of demographic information of students and teachers in relation to technology uses has been suggested as helping to understand similarities and differences in specific beliefs and technology uses of stakeholders (Constant, 2011).

Chapter 2: Review of Literature

This review of literature offers the reader the basis on which this study is designed, and provides a review of the empirical research supporting the questions of this research. The chapter is divided into sections: the development and landscape of one to one technology initiatives, frameworks to study change and the adoption of an innovation, a review of major multi-district evaluations, the teacher's characteristics and roles in one to one laptop programs, student uses of technology at home, and findings from Alaska one to one research.

A quantity of knowledge has resulted from evaluations of major one to one initiatives in multi-district implementations across different schools and in large school districts. These initiatives include large district-sponsored initiatives in Henrico County, Virginia and Talbot County, Maryland and state funded one to one initiatives in Florida, Maine, Massachusetts, and Texas. Findings from these implementations generally find (a) mixed results in student achievement gains with higher use of laptops showing the highest gains, (b) increased levels of equity to digital access, (c) increased student engagement, and (d) that teachers and students gain technology and other workplace skills (Embry, 2008). A review of relevant findings from evaluations of these initiatives is pertinent to understanding complexities involved in the study of Alaska one to one laptop initiatives in multiple districts and in the context of the investigations of this research.

As one to one laptop programs involve a number of complexities within the larger context of school, a review of frameworks that address adoption of change and technology adoption provides a means to understand how teachers change their instruction as technology is adopted. Identified aspects of frameworks from previous studies were used in this study to be able to have multiple measures of teachers' concerns and technology adoption.

2.1 Landscape of One to One Laptop Learning Environments

The cry for K12 schools in the United States to provide relevant education at high standards for a 21st century world has been increasing, and is only getting louder. The conversations in the public and among policymakers, regarding systemic issues of the rigor of our American education system; the large numbers of disengaged students within our schools; the dropouts that result; and the inertia of change in our public system, have taken center stage. Initiatives that lead to fundamental change within our schools are being considered by school leaders and funded by legislatures. Technology has been viewed as a possible solution at the heart of this effort, and school districts have made substantial investments to bring computers into schools.

The promise of technology to improve education has been a topic within research for decades (Becker & Ravitz, 2001; Russell, Bebell, & O'Dwyer, 2003a). Strategies to bring new technology into schools have taken on a variety of forms. Research done when personal computing was just beginning was focused on high access computing which provided a computer per learner in the classroom at school and at home (Dwyer, Ringstaff, & Sandholtz, 1990). This research emphasized the use of technology in the classroom in learning activities constructed by the teacher. Due to a number of reasons, including cost and the development of computer-assisted learning systems, a move away from the research became common practice for many schools, putting computers in labs based on the idea of learning from computers, instead of the teacher using computers in the classroom for instruction. This direction led to the provision of computers at a high ratio of students to computers, and the limiting of student access to the computers due to the need for scheduling time within the lab.

Limited access has been one reason cited as why teachers make limited use of technology in their classroom with students (Cuban, 2001). There is some agreement by advocates and critics of educational technology that, until technology is no longer a shared asset (i.e., a personal device for each student when he/she needs it), its potential will not be fully realized in our schools (Oppenheimer, 2003; Papert & Paperton, 1999). Today, schools continue to struggle to provide access to appropriate technology in tough economic times. Even when these high access technology initiatives are successful in gaining financial support, the complexities involved in implementing technology on a large scale have been challenging (Penuel, 2006).

Some researchers assert that the promise of technology in education will not be delivered until access to computing devices is to a point that a learner can use the capabilities of the device whenever they deem necessary (Papert & Paperton, 1999). The concept of a digital device per learner (or one to one) has regained its stature as a relevant topic in the use of technology in our educational process.

By having technology available to all students within the classroom, a potential to move from the use of the technology in an occasional and supplemental manner to one of frequent and integral use in a variety of settings is possible (Roschelle & Pea, 2002). The abilities for students to have a dedicated personal laptop to collaborate through wireless networks, visualize complicated learning concepts, participate in simulations, and the ability to use up-to-date learning resources available to all are other outcomes that have possibilities to transform the classroom (Penuel, 2006; Penuel et al., 2002).

The concept of one to one technology projects within K12 schools progressed to a new phase in the early-to-mid 2000's, as technology changed due to the continued path of Moore's Law of technology, and advances with technology becoming less expensive in relative terms, taking on new form factors, and becoming more powerful (Howell, Williams, & Lindsey, 2003; Smith, 2002). In the effort to take advantage of the promise of technology for students, high access technology projects have been employed in many schools and districts across the United States in growing numbers, as evidenced by the national ratio of students to computers falling from 125:1 in 1983 to 4:1 in 2009 (Bebell & Kay, 2009). According to the most recent United States census data on technology in schools, the ratio of students to computing devices has dropped to 3.8:1 (United States Census Bureau, 2011).

In 2006, it was estimated that close to 25% of school districts nationwide were implementing some form of a one to one laptop program (eSchool News Online, 2006). By 2010, the number of one to one laptop programs had grown throughout the country to over six thousand "ubiquitous computing" schools (schools providing a computing device per student for learning) serving over two million students (Greaves, Hayes, Wilson, Gielniak, & Peterson, 2010).

To assist schools in providing technology in ratios of one student to one computer, major initiatives across many schools in different districts, and across several states (Florida, Maine, Massachusetts, Michigan, North Carolina, Pennsylvania, South Dakota, and Texas), have dedicated millions of dollars toward one to one programs (Argueta, Huff, Tingen, & Corn, 2011; Bebell & Kay, 2009).

Research of high access technology in schools has provided evidence of significant changes in the way students learn and teachers teach. Teachers make more use of increased access to educational resources in a variety of ways, and in different representations (Dwyer, 1995; Swan et al., 2006; Zucker & McGhee, 2005). Changes in teaching toward a more student centered, project-based, inquiry-based, and constructivist model of education were also found in studies when high access learning environments are available in the classroom (Dwyer, 1995; Norris & Soloway, 2004; Rockman, 2003; Swan et al., 2006). In addition, positive changes in student behavior are also reported by studies in areas of attendance, discipline, and motivation (Dwyer, 1995; Ricci, 1999; Silvernail & Lane, 2004; Swan et al., 2006; Zucker & McGhee, 2005).

Primary studies of one to one laptop programs have been conducted in conjunction with the Maine Learning Initiative (Silvernail, 2009; Silvernail, Pinkham, Wintle, Walker, & Bartlett, 2011); The Berkshire Wireless Project (Bebell & Kay, 2010); Henrico County, VA. (Zucker & McGhee, 2005); Michigan's Freedom to Learn Program (Lowther, Strahl, Daniel, A., & Bates, 2007); Florida's Laptops for Learning project (Barrios et al., 2004; Cavanaugh, Dawson, & Ritzhaupt, 2008), and the Texas TIP program (Shapley, Sheehan, Maloney, & Caranikas-Walker, 2010).

Positive results from these one to one projects around the nation have been reported in research. Teachers were reported using laptops to develop instructional activities and materials, accessing instructional information, and communicating to colleagues. Other findings were an increase in student engagement, as well as students using laptops to complete assignments, conduct research, and become more self directed learners (Argueta et al., 2011). A conclusion among the researchers involved in studies of these one to one programs is that a variation in significance of these common findings is found due to the complexities of these large-scale efforts of reform, and the number of schools with varying focus in these multi-district programs.

Research and these large multi-year evaluations confirm that there are critical components that must be present in high access technology initiatives (Barrios et al., 2004; Bebell & Kay, 2009; Silvernail, 2009). There has been evidence that the acquisition of technology alone has not shown to be enough to promote changes in teaching and learning (Donovan, Hartley, & Strudler, 2007; Sandholtz, Ringstaff, & Dwyer, 1997; Silvernail & Lane, 2004). These reports identified critical components including (a) variables of leadership, (b) infrastructure, (c) technical capacities (connectivity, access to hardware, software, etc.), (d) support (technical, curricular, pedagogical, and political), (e) teacher professional development, and (f) supportive pedagogical beliefs and attitudes of teachers.

2.2 Frameworks of Change.

In order to evaluate and categorize student and teacher levels of technology usage, this study uses a conceptual framework of teachers' technology adoption to arrive at a common terminology of practices. Several models of technology adoption within high access laptop learning environments have been developed, and they show how teachers adopt new innovations, including innovations such as one to one laptop programs. These frameworks have been used in studies to measure technology adoption from different perspectives. Predictable stages of concern about innovation, and predictable movement through changes of behavior in technology adoption over time have been indicated for teachers involved in one to one laptop programs. Understanding these predictable stages is useful in the design and implementation of one to one computing programs to better effect the design of learning activities for students and improvement of the learning environment.

A review of these frameworks of change to best determine the model to use for this study of Alaska schools was indicated. Four conceptual frameworks of technology adoption were reviewed in depth: a) the Concerns Based Adoption Model (CBAM), (Newhouse, 2001), b) the Apple Classrooms of Tomorrow's (ACOT) Evolution of

Thought and Practice (ETP), (Dwyer, 1995), c) the Diffusion of Innovation (Rogers, 1995); and d) the SAMR Technology Adoption Cycle (Puentedura, 2008). A review of the four models demonstrate how classification of levels of usage may be helpful in establishing a profile within a study and provide a means for a substantiation of responses with a survey method.

2.2.1 Concerns Based Adoption Model (CBAM).

All of the models mentioned above have origins in the CBAM as described in Newhouse, (2001). The CBAM was developed to measure teacher concerns about a variety of pedagogical innovation in their classrooms (Fuller, 1969). Subsequent researchers developed a variety of models to specifically measure the impacts of technology integration in the classroom, resulting in a number of modified frameworks. CBAM includes three different dimensions: the Stage of Concern (SoC), Level of Use (LoU), and the Innovation Configuration (IC). The SoC measures how a teacher perceives an innovation, and uses a common set of stages to describe how they feel about the innovation. The LoU has to do with behaviors and attempts to determine how people act within the change (Hall & Hord, 2011). The LoU assumes that individuals move from one stage to another in a linear fashion as the innovation is used over time, and identifies each stage by what the teacher is doing. The IC dimension outlines the innovation by defining the attributes of it. A series of statements (or components) is arranged to describe how successfully the implementation of the innovation is supported by the gathered data through a variety of means.

The teacher SoC is a reflection of the personal concerns of an innovation, and is represented in six stages. Teachers are placed within the stages as they answer questions directly related to their level of concerns for the innovation, in this case, implementing the one to one laptop program. These stages proceed in a hierarchy from (a) awareness, to (b) personal/informational, to (c) management, to (d) consequence, (e) collaboration, and (f) refocusing. Open ended questions are also used so that participants can describe other concerns more deeply (Hall, 1995). Table 1 helps to define these stages of concern.

Table 1:
Stage of Concerns (SoC) about Innovations

Type of Concern	Stages of Concern	Expressions of Concern	Definition
Unrelated	Stage 0 Awareness	I am not concerned about it	Little concern about of involvement with the innovation is indicated
Self	Stage 1 Informational	I would like to know more about it.	A general awareness of the innovation and interest in learning more detail about is indicated. The individual seems to be unworried about himself/herself in relation to the innovation. She/he is interested in substantive aspects of the innovation in a selfless manner, such as general characteristics, effects and requirements for use.
	Stage 2 Personal	How will using it affect me?	Individual is uncertain about the demands of the innovation, his/her inadequacy to meet those demands, and his/her role with the innovation. This includes analysis of his/her role in relation to the reward structure of the organization, decision-making, and consideration of potential conflicts with existing structures or personal commitment. Financial or status implications of the program for self or colleagues may also be reflected.
Task	Stage 3 Management	I seem to be spending all of my time getting material ready.	Attention is focused on the processes and tasks of using the innovation and the best use of information and resources. Issues related to efficiency, organizing, managing, scheduling, and time demands are utmost.
Impact	Stage 4 Consequence	How is my use affecting my clients?	Attention focuses on impact of the innovation on clients in his or her immediate sphere of influence. The focus is on relevance of the innovation for clients, evaluation of outcome including performance and competencies, and changes needed to increase client outcomes.
	Stage 5 Collaboration	I am concerned about relating what I am doing with what my co-workers are doing.	The focus is on coordination and cooperation with others regarding use of the innovation.
	Stage 6 Refocusing	I have some ideas about something that would work even better.	The focus is on the exploration of more universal benefits from the innovation, including the possibility of major changes or replacement with a more powerful alternative. Individual has definite ideas about alternatives to the proposed or existing innovation.

Adapted from (Dalgarno, 2009).

The LoU is designed with eight categories which describe how an individual behaves with the innovation. Three of the categories address non-use, and five address use levels. The LoU is like the SoC in that it assumes progression from one level to another over time. Table 2 helps to understand each level of use, and the behaviors associated to that level.

Table 2:

Levels of Use (LoU) Stages and Associated Behaviors

Levels of Use			Behaviors Associated with Level
Non –Users	0	Non-Use	Little or no knowledge of or interaction with the innovation.
	I	Orientation	Takes actions to learn more about the innovation.
	II	Preparation	Decision to use innovation but not yet started.
Users	III	Mechanical	Actively engaged with the innovation through experimentation.
	IVA	Routine	Mastered the innovation and has sufficient support.
	IVB	Refinement	Reflection and assessment of how the innovation benefits clients.
	V	Integration	Adaptation of the use of the innovation for the benefit of the client.
	VI	Renewal	Exploration of major modifications to the innovation or looking for a replacement.

Adapted from (Dalgarno, 2009).

2.2.2 Evolution of Thought and Practice.

The teacher technology adoption cycle developed through the Apple Classroom of Tomorrow (ACOT) research by Dwyer, (1995) through the Evolution of Thought and Practice (ETP) builds on the CBAM model and focuses directly on instructional change from having high access to technology available. The ACOT studies spanned a nine-year period. Teachers and students within the ACOT research were supplied with a desktop computer at school and at home in addition to supporting peripherals, with the primary question of research being "What happens to students and teachers when they have access to technology whenever they need it?" (Dwyer, 1995).

A framework of growth in teacher use of technology was developed and refined in five sites over a period of four years (Dwyer et al., 1990). This framework came from data collected through audio taped teacher journals and weekly written staff reports totaling over 13,000 episodes indexed according to content. A hierarchy of movement through the adoption of technology use in the classroom was identified as teachers moved through stages of uses categorized as (a) entry, (b) adaptation, (c) adoption, (d) appropriation, and (e) invention. To understand this framework, Table 3 is offered.

Table 3:

Levels of Evolution of Thought and Practice (ETP)

Entry	Learning the basics of using technology. Technical issues are barriers. Experienced teachers encounter first-year teacher issues of discipline, management of resources. A critical stage in subsequent use of technology in the classroom.
Adaption	Successfully using technology on a basic level in ways consistent with existing teaching preferences and learning practices
Adoption	Move from basic use to using technology with greater productivity results. More frequent and goal-oriented use of technology, but little change in existing teaching and learning practices. Lecture, recitation, and seatwork are still dominant student tasks.
Appropriation	Technology is used "effortlessly" as a tool to accomplish instructional and administrative goals. Teacher roles shift into more student centered activities. Teacher has knowledge of what the technology can do and "appropriates" how to use it in their teaching.
Invention	Technology is used as a flexible tool in the classroom creating a technological environment. Learning is more collaborative, interactive and customized; new teaching and learning practices emerge. More interdisciplinary studies seen.

Adapted from (Dwyer et al., 1990; Sandholtz & Reilly, 2004).

Similarities between the CBAM and the ETP are significant, and captured in Table 4, adapted from (Trinidad, Newhouse, & Clarkson, 2006).

Table 4:

Comparisons of the relationship of the CBAM and ETP

Stage	CBAM	ACOT ETP
1	Awareness of technology but hasn't used it yet.	
2	Learning the process: Learning the basics of technoloy use, but with a lack of confidence and a tendency to get frustrated	Entry: Learning the basics of new technology
3	Understanding and application of the process: Beginning to understand how to use technology and can think of specific tasks in which it might be useful in traditional instruction	Adoption: Use technology to support traditional instruction
4	Familiarity and confidence: Gaining a sense of confidence in using technology for specific tasks	Adaptation: Integrate new technology into tradtional classroom practice (often with a focus on the use of word processing programs, spreadsheets, and/or graphics tools)
5	Adaptation to other contexts: Using technology with confidence- can use it in different contexts and as an instrucitonal aide	Appropriation: Focus on cooperative, project-based and interdisciplinary work incorporating the technology as needed
6	Creative application to new contexts: Integrating technology into the curriculum and using technology as a tool. Independently learning new technology to accomplish instructional goals	Invention – Discovers new uses for technology tools, such as designing projects utilizing multiple uses of technology.

Adapted from (Trinidad, et. al. 2006)

2.2.3 Diffusion of Learning.

Another accepted model of change is the Diffusion of Innovation (Rogers, 1995, 2003). Roger's model describes how individuals within an organization adapt to, and adopt new innovations over time, until the changes that are introduced are accepted as the norm. Rogers identifies five factors for the rate of adoption of an innovation: (a) relative advantage, (b) observability, (c) compatibility, (d) complexity, and (e) trialability. When teachers consider technology in the classroom, each factor of this framework is very applicable. Relative advantage is the consideration of the cost/benefit of whether it is worth the time, effort, and risk to change current practices and behavior to use the technology instead. Observability of the results of technology use relates to whether or not the teacher can see the benefits of its use. If results of higher student achievement, increased student engagement, or higher quality work were seen, a teacher would be more receptive to change practices. A high degree of compatibility to the needs, beliefs, and experiences of the teacher, and use of technology would lead to a higher degree of adoption in Roger's framework. A low degree of compatibility could result from a teacher not having technology as a part of their teacher training, or low personal use of the technology. The complexity of technology in the classroom also influences the adopter. The ease of use, level of maintenance effort, and support levels needed for the technology influence the teacher's adoption rate (Dias, 1999). Finally, "trial-ability" speaks to the permanence of the innovation. In Roger's framework, if a teacher can try something and decide to discard it, it would positively affect the adoption rate. In terms of a one to one laptop program, this would be a difficult thing to do.

Five descriptors are outlined in this framework: (a) innovators, (b) early adopters, (c) early majority adopters, (d) late majority adopters, and (e) laggards. From studies over a period of more than 60 years, Rogers calculated that 84% of people lie within the first four descriptors, with laggards making up approximately 16%. This distribution is represented in the following Figure 2 from Effik, (2011).

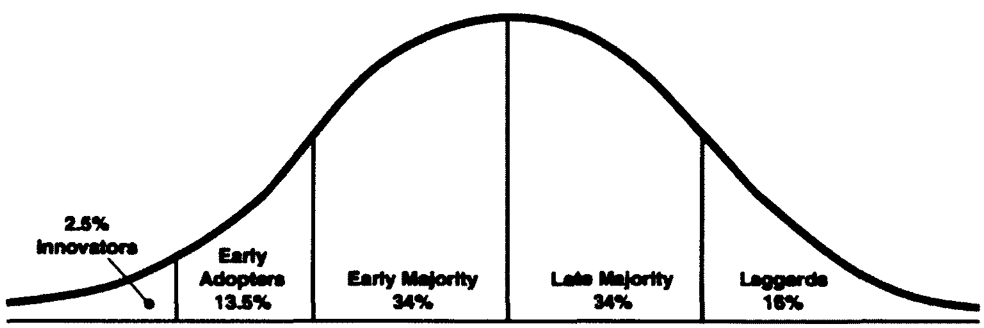

Figure 2. Roger's Diffusion of Learning

2.2.4 SAMR Technology Adoption Cycle. The SAMR Technology Adoption Cycle categorizes technology usage by type of pedagogical approach along with the type of technology that is used (Puentedura, 2008). The SAMR suggests that a technological tool: (a) may be used for substitution (S) of a existing tool with no functional improvement shown, (b) may be used to augment (A) instruction so that it is still used as a tool but shows functional improvement, (c) may be used to modify (M) a learning activity to bring about a relevant change in function and change the activity in significant ways, or (d) it may be used to redefine (R) an activity where new tasks that were previously inconceivable can be utilized for learning. This approach advocates that greater sophistication of a technological tool can allow a teacher to use it in high levels of technology integration in learning activities, but it is the level of the pedagogical method that is the limiting factor in most cases. While useful to understand the SAMR in regards to teacher technology progression through the stages, a research study that used Puentedura's SAMR as an index framework for categorizing teachers' level of technology adoption could not be found by this author.

Each framework has its strengths and weaknesses, and no one model can fit the circumstances or environment that any individual teacher may be working in (Trinidad et al., 2006). Trinidad separated these frameworks into four categories: (a) learning micro models, (b) information computer technology (ICT) oriented micro models, (c) systems/schools models, and (d) population models. Analysis of the frameworks reviewed in this paper places CBAM in the learning micro model, ACOT's ETP as an ICT-oriented micro model, and Roger's Diffusion of Innovation as a population model.

Trinidad suggests that a population model is useful for descriptive purposes, but is not an explanatory model to provide guidance on how to improve rate of adoption. The CBAM is viewed as being more focused on the individual and his/her concerns moving through stages of development, as well as having a better learning orientation. Characterized as an ICT-oriented model, ACOT's ETP establishes a hierarchy of teachers' use of technology that is more clearly focused on prescribed professional development for teachers to advance through its levels. Puentudura's SAMR is helpful to determine levels of use within specific applications, but seems to be more transitionally based upon the teacher's instructional learning objectives and the need for the use of the application. While ACOT's ETP focus is to provide support for professional development, it lacks teacher voice in terms of concerns of implementation. This finding is also supported by (Dalgarno, 2009), as a basis for her study. The CBAM has been successfully used for large institutions and projects (Hall & Hord, 2011). Therefore, the CBAM SoC and LoU will be used to find individual teacher concerns as one of the primary bases of this investigation, in order to provide a descriptor of teacher adoption positions along that framework. Relationships to the ACOT ETP will be included in this study.

2.3 Review of Major Multi-District One to One Implementations

2.3.1 Henrico County.

One of the first large-scale one to one laptop initiatives in the United States was in Henrico County School District in Virginia and began in 2001, when 25,000 students and teachers were given laptop computers to use an instructional tool. Principal goals of the project were to improve teaching and learning, improve administrator and teacher productivity, improve communication with parents, and narrow the digital divide of the school population. An evaluation was done in 2004 through a National Science Foundation grant to Science Research Institute International (SRI) and Education Development Center (EDC) to collect data about laptop use in science and mathematics in select schools in the school district (Zucker & McGhee, 2005). The grant was a part of a larger study supporting a network of evaluators working in many one to one learning environments in the United States, especially in math and science.

The Henrico mixed method study included site visits in two middle schools and two high schools in each of two school years. Interviews and focus groups with over 100 administrators, school staff, students, and parents were conducted. Survey data was collected from 200 math and science teachers and 300 students but was not used due to low response rates.

Findings from the study were generally positive, with interviews of stakeholders revealing that students demonstrated increased motivation, engagement and self-directed learning, were better organized, and had more interaction with teachers. Teachers were reported to have easier access to up-to-date instructional content, more flexibility during instruction, increased professional productivity, and greater collaboration with other teachers. They also changed practices to manage classrooms and discipline. A stated goal of school-home communications was improved.

The absence of the surveys from teachers and students was a disappointing aspect to this study. Bias due to a poor return rate was cited for non-inclusion. This data would have revealed more of the universal strategies used by the teachers in their instruction and student reported use had an acceptable sample been available.

The Henrico study was instrumental in the development of a framework for the evaluation and research of a one to one initiative. This framework provided a starting point to understand the implications of a one to one laptop program and to guide future evaluation studies in issues to be examined. The framework also shows hypothesized relationship between three sets of variables when a school implements a one to one initiative. The boxes within Figure 3, adapted from (Zucker, 2004), from left to right identify (a) the critical features of a one to one initiative, (b) interactions of different participants in the initiative and associated intermediate outcomes of the initiative, and (c) ultimate outcomes that might be realized as a result of the implementation.

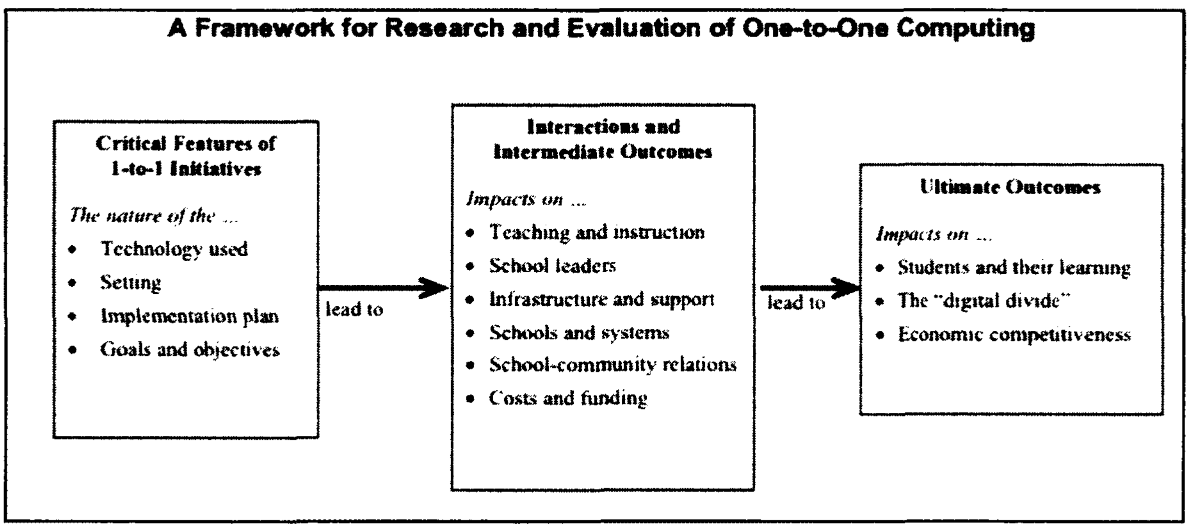

Figure 3. Framework for research and evaluation of one to one computing

There is value of restricting the many outcomes of a one to one laptop program that could be measured as final outcomes. The narrowing of the final outcome goals is an effort to provide value to a broad range of evaluators and researchers (Zucker, 2004). The inclusion of economic competiveness is an example of a large goal that cannot be measured in a quantitative method in an efficient manner. This type of goal has been elusive for researchers to find data to determine the effectiveness of one to one initiatives and has led to confusion and criticism of one to one implementations. While researchers have tried to build the support for the outcomes of one to one implementations and goals such as economic development, these ideas are loosely affiliated when the students involved do not enter the workforce for many years and data on the importance of having been in a one to one laptop programs is lacking (Lemke & Coughlin, 2006).

2.3.2 Talbot County Public Schools – Talbot County, Maryland.

In 2005, Talbot County Public Schools began a staggered implementation of a one to one laptop initiative that began with the 9^{th} grade cohort in two high schools. Upon entering the ninth grade, this cohort was given a laptop upon entry into school and then kept the laptops as they advanced through the grades each year. Teachers were trained the summer before students would enter their classes and had their laptops with ongoing support provided through the year. A yearly evaluation was done by Johns Hopkins University in each of the first five years (Talbot County Schools, 2010). While smaller in size to other multi-district implementations (n ~ 400 year one to n ~ 1200 year four), this study offers much learning about the critical components of a one to one laptop program.

The goals of this project were four-fold: (a) increase student achievement, (b) provide effective use of technology for instruction, (c) increase student engagement, and (d) improve education access for and participation by high-risk students. Consistencies in the survey evaluation were carried over every year of the study centered upon the four goals of the study. Every year of the study, increases in student achievement of laptop students versus non-laptop students and students attending Talbot County high schools before the initiative were reported in areas of grade point average, pass rates, and mean scores of the Maryland High School Assessment tests (Johns Hopkins University, 2006, 2007, 2009a, 2009b; Otto, Hannon, Mainzer, & Bautz, 2010). The planned approach to this initiative encompassed the following components outlined in Table 5.

Table 5: *Components of Talbot County Schools one to one laptop design*
Alignment of the laptop program to well-defined goals
A strong leadership team at all levels
Long-term funding commitments
Ongoing stakeholder involvement and partnerships
Systemic integration of technology in curriculum and instruction
High-quality professional development
A well-maintained infrastructure and network architecture
Careful planning of all logistics
Strong and ongoing technical support at all levels
Monitoring and evaluation

Adapted from (Otto et al., 2010)

In the first two years, teachers' journeys of technology integration were measured through questions focused on the CBAM framework. Teacher movement into the high stages of innovation adoption showed that teachers adapted quickly through the stages by moving through the following progression summarized from the survey results of two studies. Table 6 shows that progress.

Table 6:

Teacher's concerns of Talbot County Schools teachers by CBAM 2005-2007

Year	Stage of CBAM Framework				
	Awareness and learning the process	Understanding and applying the process	Familiarity and confidence	Adaptation to other contexts	Creative applications in new contexts
	Stage 1-2	Stage 3	Stage 4	Stage 5	Stage 6
Mid Year 2005-2006	0	9	45	28	18
End of Year 2005-2006	0	0	28	44	28
2006-2007	0	6	15	30	49

Summarized from (Johns Hopkins University, 2006, 2007)

This movement through the CBAM model of adoption (shown in Table 6) was attributed to the fidelity of the implementation design including adequate teacher development and support. Initially, teachers were encouraged to write and share journals with the newly established Staff Development Specialist, as well as communicate through a newly established "Vanguard Team," a group of technology-savvy teachers who became peer mentors and a "Technology Coach," which served as a liaison responsible for creating bridges between the leadership team, IT staff, and teaching staff. A high degree of support was reported by teachers consistently over the years, attributed to the ongoing support provided by a distributed model. (Johns Hopkins University, 2006, 2007, 2009a, 2009b; Otto et al., 2010).

2.3.3 Florida.

The State of Florida TitleII/D Enhancing Education Through Technology (EETT) grant program provides studies of a major state initiative. An initial report, "Laptops for Learning," from the Laptops for Learning Task Force to the Florida Department of Education made recommendations of a statewide coordination of a measured implementation of one to one laptop computing (Barrios et al., 2004). This recommendation reviewed other major one to one initiatives around the country, conducted a cost/benefit analysis of mobile computing in a 24-hour/7 day per week scenario, and provided an analysis of equity of educational opportunities. A non-scientific teacher survey had 350 respondents from pilot schools within the state to establish an understanding of technology use.

The recommendations of this study led to the implementation of the "Learning with Laptops" program. Academic promise was deemed substantial enough for the State of Florida to fund 11 school districts to implement "ubiquitous computing" by meeting the definitions identified by the Task Force. The goals for the project included changing teaching practice through professional development and technology afforded by laptops, leaving autonomy to districts in meeting the goals according to their unique needs (Dawson, Cavanaugh, & Ritzhaupt, 2006). Teacher participation in a state sponsored "Digital Educator" professional growth series was a common requirement as was participation in the mandated statewide research projects.

The research to evaluate the Learning with Laptops program used a combination of theoretical frameworks offered by Zucker & McGhee, (2005), and another suggested earlier by Hall, (1995) in a mixed methods study resulting in the analysis of data collected in teacher surveys, classroom observation, and teacher reports on student achievement (Cavanaugh et al., 2008). The study included 440 classrooms within 47 K12 schools in the 11 funded districts. Following the modified Zucker/Hall framework, three areas were examined: (a) conditions, (b) processes and (c) consequences. Table 7 categorizes the aspect of each area of exploration.

Table 7:

Florida "Laptops for Learning" one to one laptop research framework

Conditions	**Processes**	**Consequences**
Technology used	Professional development	Student achievement
Setting	Teaching practices: student-centered and tool-based	Changes in teacher practices: student-centered and tool-based
Implementation plan	Technology deployment	Impact on parents
Goals and objectives	Support	Sustainability
	Parent involvement	

Adapted from (Cavanaugh et al., 2008)

Classroom observations in the study showed significant changes in teacher practices and classroom interactions. Table 8 summarizes findings from the classroom observations.

Table 8:

Observed Changes through research of teacher practice in Florida

Teacher Practice	Observations from first half of research year	Observations from second half of research year
Use of direct instruction	90%	78%
Use of independent seatwork	85%	54%
Use of collaborative/ cooperative approach	30%	50%
Use of project based learning	20%	50%
Teacher as a coach/facilitator	40%	70%
Use of technology as a learning resource	42%	72%

Adapted from (Cavanaugh et al., 2008)

One of the aspects of the research design in the Florida study was active research. Teacher action research was defined as an intentional inquiry carried out in a systematic manner concerning one's own professional and teaching practice (Cochran-Smith & Lytle, 1993). An active research mentor was assigned to each district to assist teachers in their own research during the school year. Forty-six teachers participated in this phase of the research. Nearly all teachers reported improvement in student performance and long-term effects of the laptop program in their professional life, including 15 that had taken leadership action to share their successes with other professionals. Seventy-six percent (76%) of action research teachers reported changes in student achievement. Three of the 46 classrooms reported negative changes due to inexperience of students with the technology, causing them to learn the technology at the same time they were learning classroom material. All others reported noticeable positive improvements in student achievement (Cavanaugh et al., 2008).

The framework of change included in this study examined conditions, processes, and outcomes and provided context for the discussion of the assumptions of this research proposition (Hall & Hord, 2001). This project is similar to the project in Alaska in that, while districts had similar solutions for the anticipated barriers of a one to one implementation, each district had leeway to design the model of implementation which best suited its unique needs. The Florida study differs from the Alaska story in that the schools in Alaska all had outside recommendations and specifications to guide their implementations in regard to technical infrastructure upgrades, assistance with timely hardware repair, and a quantity of technical and professional development opportunities thus creating similar technical conditions and generalized instructional strategies centered on software capabilities in regard to reducing barriers to implementation.

2.3.4 Maine.

Many of the evaluations of multi-district multi-school projects inventory teacher uses of technology tools in the classroom. In one of the longest running large-scale programs established in the United States, Maine introduced the "Maine Technology Learning Initiative" in 2002 to an initial population of 17,000, 7th grade students, and their teachers in over 240 schools across the state (State of Maine, 2011). The following year, all new seventh grade students also received a laptop as the program was extended into 8th grade. A team of researchers over a period of 8 years compiled numerous studies concerning various aspects of one to one implementations and impacts.

One of the ongoing studies was to determine levels and frequency of laptop use by students and teachers (Silvernail et al., 2011). This most recent study of the Maine story utilized a teacher survey representing over 1690 teachers in the spring of 2010. Participants represented approximately 38% of all middle school teachers in the state. Answers to questions regarding categories of frequency and type of use as a curriculum and instructional tool and a management and communication tool were reported as well as common answers to questions in previous studies regarding the same categories. Teachers responded to questions on use on a six-point Likert scale ranging from "Never Used" to "Often during the day". The top three response categories ("A few times per week", "Once daily", and "Often during the day") were combined and reported in the study.

More than 75% of all teachers reported using their laptops as a curriculum and instructional tool to: (a) develop instructional materials, (b) conduct research for lesson design, (c) find quick facts to inform teaching, and (d) include with instruction. A little less than 60% of teachers reported use of the laptop to differentiate instruction and in assessment (formative or summative).

More than 75% of all teachers also reported that they used the laptop as a management and communication tool to: (a) record student grades, (b) manage student information, (c) communicate with colleagues inside and out of school, and (d) communicate with parents.

Due to the commonalities of questioning in previous studies, use levels over time could be reported. Figures 4 and 5, adapted from Silvernail et al., (2011) show the increases of the percents of teacher's level of use of technology over time.

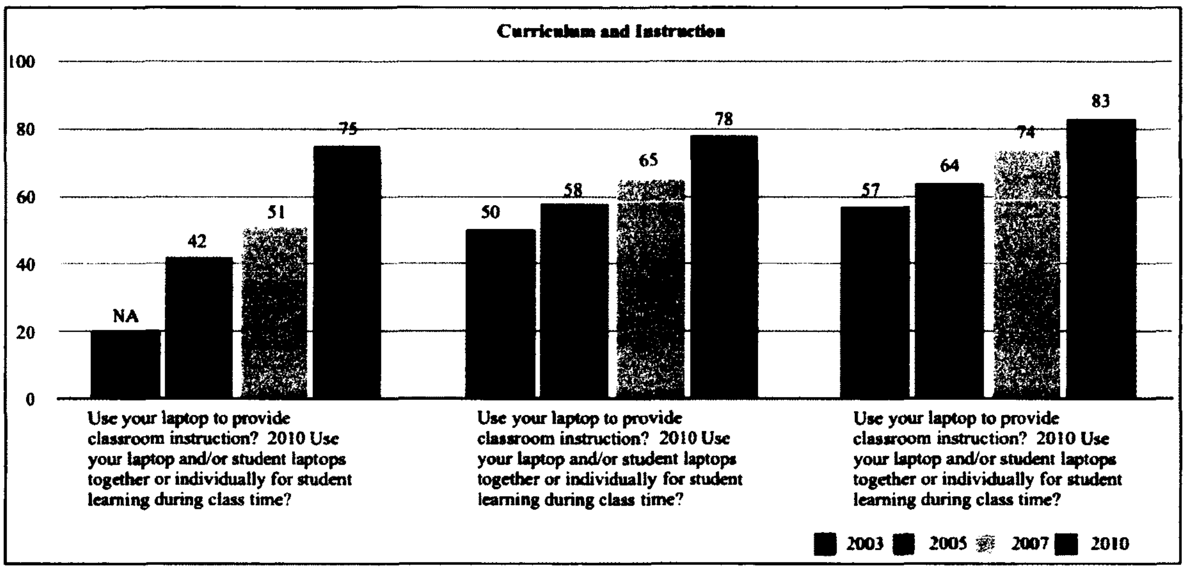

Figure 4. Maine teacher laptop use as a curriculum/instruction tool over time

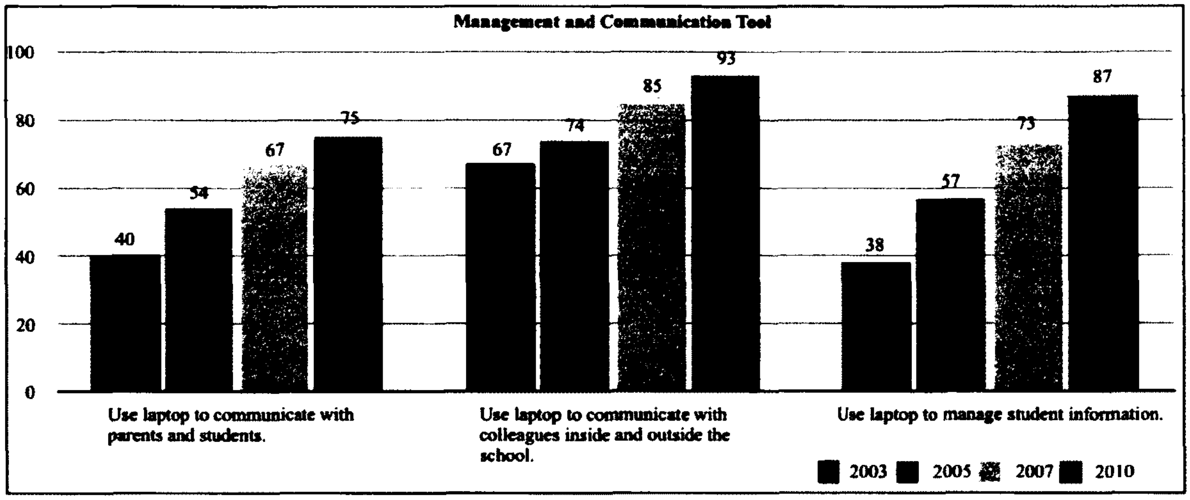

Figure 5. Maine teacher laptop use as a management/communication tool over time

An effort was made to answer the question of what are desirable levels of use of technology by teachers (Silvernail et al., 2011). The Diffusion of Innovation framework of change was employed to better understand the findings of the study (Rogers, 2003). Silvernail postulated that, while striving to achieve 100% adoption of an innovation, that laggards may never well adopt the changes. By setting the bar at 84% adoption, an assertion was made by excluding the percentage represented as laggards; after eight years of laptop deployment in Maine middle schools, teachers may be at the adoption stage of change in those areas approaching or exceeding the 84% adoption rate (as in Figure 3 and 4) and not yet reaching adoption stage for those areas not yet reaching the 75% level of adoption levels in areas of differentiation of instruction and assessments. Teacher characteristics were also analyzed in areas of age, gender, education level, and years of teaching showing no general relationship to any demographic item. Teachers in different disciplines showed some significant differences. Over 80% of teachers in disciplines of language, social studies and science indicated frequent use in the classroom instruction while less that 75% of math teachers and less than 70% of fine arts and foreign language indicated frequent use of technology. Teachers who perceived themselves as having a high level of competency with technology reported using technology in lessons frequently three times the amount of what teachers perceiving their technology competency as low.

Silvernail also presents a caution against trying to determine causal relationships from descriptive data. A relationship to use levels of technology and a particular demographic does not disclose which, if either, is causal or an effect.

2.3.5 Massachusetts.

The role of teachers and students in using technology becomes an integral part of research relating to results of a laptop implementation. The Berkshire Wireless Project was considered to be a pilot program and was implemented across five middle schools in Massachusetts with every student and teacher (approximately 2700) having access to a laptop throughout the year (inTASC, 2011). In addition, schools were equipped with wireless networks, technical and professional development and additional supports to help teachers integrate the technology. The student cohorts from the five schools were compared to control groups of students in two neighboring middle schools who did not have access to a laptop during the day. In this study, data from final outcomes of the project were analyzed and were compiled with the data accumulated from two previous years of study in 2009 (Bebell & Kay, 2009). Using a pre/post comparative design, this evaluation covered a wide range of outcomes but was centered around four main areas: (a) fundamental shifts in teaching practices and improved student engagement, (b) enhanced student achievement, (c) enhanced student research, and (d) student capabilities to engage in independent research and collaboration. Data was gathered through quantitative measures of student and teacher surveys, analysis of existing student achievement data and a mock state achievement test given by both computer and pencil and paper and qualitative measures of classroom observations, student drawings and teacher/leadership interviews.

Due to the nature of the evaluation as part of the funded project and extraordinary communication with school leaders regarding survey completion rates of teachers, response rate on surveys was very high in the experimental group of students (98.7%) versus the control group of students (74.6%) in the comparative middle schools. This was also true for teacher participants with the surveys, with 97.6% response rate from the experimental group and a 57.6% response rate from the comparative teacher groups.

This Berkshire study analyzed student achievement by looking for trends in statewide assessments over time and to see if student technology use in school and at home had any effect on those scores, all while controlling for pre-laptop program prior performance on those assessments. A linear regression analysis was used with the state assessments of the study's current year serving as the dependent variable and the student's pre-laptop assessment serving as the independent variable (control) for the prior level achievement (Bebell & Kay, 2009).

As with the previous stated studies, one common finding was that schools implemented the one to one laptop programs in different ways leading to different outcomes. Bebell went on to report in universal findings that went beyond the four areas identified for evaluation. Universally positive changes were found in all areas of evaluation as well as in the perceptions of students, teachers, and school leaders about changes that had occurred in their schools. Through the combined methodological approaches and statistical analysis, changes of teaching and learning were documented in the vast majority of classrooms. These findings were not universal throughout every classroom with reasons cited being differences of degrees of adoption and use of technology by the teacher and uniqueness of school environment (inTASC, 2011).

2.3.6 Texas.

In a study of the Texas TIP (Technology Immersion Program), 21 schools were followed using a prescribed hierarchical model of implementation regarding one to one laptop learning in a statewide initiative (Shapley et al., 2010). Researchers investigated causal effects of technology infusion on teacher perception of different aspects of schooling, student achievement and implementation fidelity to a prescribed model. This quasi-experimental study followed three groups of cohorts over a three-year period using student and teacher surveys around technology use in the classroom as well as state mandated standardized tests. Indices were established concerning teacher perceptions in areas of leadership, technical support, innovative culture, and parent/community support. Professional development was also an emphasis within the teacher survey as well as teacher perception from indices developed from topics of (a) personal productivity, (b) classroom activities, (c) technology integration, and (d) learner-centered instruction. Between six and seven thousand students were surveyed each year in areas of student laptop access, the frequency of laptop use in classes, and the home of use of the laptop.

The analysis of implementation fidelity revealed only six of the 21 schools achieving substantial levels of implementation at the end of the study. The researchers found that interpretation of the prescribed model of implementation of this statewide model was subject to teacher perception, and schools had substantial difference in perceptions of what the implementation model specified, versus what was reported. Modifications were made to the implementation model by individual schools in regards to accessibility of the laptops to students at home being one of the most directly affected characteristics, decreasing over the time of the study. Over time, schools tended to disallow student use at home, and put the computers on carts in the schools due to aging equipment, policies restricting student use, and teacher preference. These findings reinforce the need for clear communication of project goals, implementation components, and ongoing leadership involvement in project direction.

Positive results were significant in areas of teacher technology proficiency for professional productivity, however these results did not necessarily reflect increases in classroom use of technology. In other words, teachers viewed the technology as a more important tool for their use rather than for students. Positive increases were found in areas of the index "Classroom Activities," in the (a) frequency of technology use, (b) small group work, (c) frequency of interaction between classmates, (d) discipline and (e) behavior. Academic achievement in mathematics was positive in statistically significant measures across all cohorts; .20 effect size for cohorts using laptops for three years, .16 for cohorts using laptops two years, and .13 for cohort with laptops for one year.

A two-level hierarchical linear model was used to nest individual students within teachers' classroom and analyzing different measures of aspects of the implementation model to determine predictors of variables of student achievement. When isolating individual variables and determining effect size, the strongest implementation predictor for increased student achievement in the HLM model was student use of laptops outside of school for homework and learning games. This finding is ironic in that home use of the laptop decreased over time with this project.

2.4 Teachers' Characteristics and Roles in One to One Laptop Programs

The importance of teacher roles and pedagogical beliefs about an innovation in education has been addressed in a number of research studies. This section will review pertinent studies that build a background of how teacher beliefs and concerns are addressed in this study.

The roles a teacher can play integrating technology into instruction has gained some attention from research but has been centered around their role in providing learning activities for students in the classroom. A major role change that has been advocated is the change from an information giver to that of a facilitator (Sebastian, 1996). This change represents a move to a more student centered approach, where students take more responsibility for their learning as the teachers become more of a "partner in learning" (Fairman, 2004, p. iii). In the qualitative study conducted within the Maine Learning with Technology Initiative, over 300 coded interviews resulted in findings that the partnership in learning previously noted resulted in a change of roles of students assuming roles that traditionally had been the teachers and that the teacher became more of a learner in regards to the use of technology (Fairman, 2004, p. 5). Limited time had been allowed for teachers to become comfortable with the technology before students were issued laptops, forcing teachers to take help from anywhere they could find it. Teachers categorized their relationship with students as "reciprocal," meaning that they viewed students as "valuable teachers" as the teacher became a "learner" (Fairman, 2004, p. 14). Due to teacher's openness to innovation, and the assumption of a learner attitude, changes in instruction and more student engagement and motivation were noted.

A similar view of teachers becoming more student centered is when teachers share beliefs of a constructivist viewpoint (Becker & Ravitz, 2001). While not centered on one to one implementations, valuable information on the changes in teachers' behavior can be found in this survey. In the survey of over 4100 teachers in over 1100 schools, variables were found to support increased technology use within the classroom. The variables indicating increased use included (a) a number of computers in a distributed manner of 5 – 8 computers in the classroom rather than a computer lab, (b) teachers having greater technical expertise with computers, (c) active professional engagement by the teacher, and (d) an extensive background on different computing platforms. When teachers were professionally active by giving presentations, participating on committees, and engaging in conversations with peers regarding technology, they were six times as likely to fall under the studies category of "Exemplary Computer User" than the teachers who had limited involvement with other teachers (Becker & Ravitz, 2001, p. 12).

Following the idea that teachers who have greater expertise with computers and who have a more extensive role in different computing applications, a survey tool called the Professional Technology Profile (PTP) was developed to ascertain the roles played by teachers in and outside of the classroom (Lemke, 2009). The PTP is based on the idea that those educators who are engaged with current technologies in their personal and professional life have an advantage of using these technologies in their classrooms for student benefit. As students continue to use technology at increasing rates outside of school, teachers who use technology themselves experience societal uses that mirrors students experience.

The PTP makes three primary distinctions in the role of technology in the lives of teachers: personal use, use in professional practice, and use in the classroom with students. Personal use pertains to the use of technology in daily activities of life of the individual. Use in professional practice is how teachers use technology to prepare for, deliver, and grow as a professional in the course of their work. Technology use in the classroom are those uses that involve students in learning activities in the classroom.

Questions within the survey are weighted according to the complexity of use and the adoption level of the technology, with newer technologies (such as wikis or blogs) given more weight than more established technologies (such as email).

With this survey tool, the roles teachers play in areas of their personal and professional lives are ascertained through self-reported measures of technology use and in uses of technology in the classroom. Teachers are placed on a continuum of the quantity and quality of technology use in each role. Definitions of roles of the teachers in the survey are represented in Table 9.

Table 9:

Definition of teacher roles using technology in PTP

Definitions of Roles
Change agents help others envision new uses for technology, influencing how, when, and how well others use it.
Connectors use technology to interact more effectively, efficiently, and cooperatively with others to accomplish individual and group results.
Developers use technology to design and create better quality products or processes.
Contributors use technology and media to offer original perspectives, interpretations, reflections, commentaries, and links or references to others' works.
Consumers use technology as guided or directed to improve their understanding or the quality of their work and experiences.

Adapted from (Lemke, 2009)

Categories of Levels of Use or Expertise are presented in Table 10.

Table 10:

Continuum of categories of level of use or expertise of PTP

Continuum Categories
Innovate, using technology critically, creatively, and thoughtfully
Accomplish, using technology efficiently and effectively to get optimal results
Commit, recognizing and striving to optimize the added value of technology
Comply, using technology only as required
Ignore, disregarding technology use whenever possible

Adapted from (Lemke, 2009)

Rubrics were developed for each role of within the survey instrument: change agent, connector, developer, contributor, and consumer. Each role had a continuum category of proficiency indicated by ignore, comply, commit, accomplish and innovate. These rubrics represent the depth of technology use that teachers report through the questions of the survey instrument.

The teacher has been identified as a crucial gatekeeper of infusing technology into learning activities. In the Berkshire Wireless Program, teachers were observed to control nearly all of the use of the technology during the school day (Bebell & Kay, 2010). Teachers controlled the timing and application of how students used the technology in each of their classes. The analysis of technology use across subject matter and grade levels were not statistically significant, which pointed to the teachers' adoption of technology becoming a larger role in the adoption and use of technology. The researchers acknowledged and summarized that the potential success of any one to one program rests largely on the participating teachers' adoption and use of technology for educational purposes. Factors influencing teachers' adoption of technology included (a) teachers' beliefs and attitudes toward pedagogy and the value of technology within it, (b) quality and timeliness of technology support, (c) ease of access to needed technologies such as projectors, printers and other peripherals, and (d) professional development and training. It was also found that teacher age was not largely related to increased use of technology in the classroom.

Another interesting side note of the Berkshire study was the way survey results were reported (Bebell & Kay, 2010). All schools were identified by name in the study along with their response rates. Two schools had small numbers of teachers and did not have good response rates, so noted in the study. It would be very easy to ascertain the identity of these teachers and prejudice readers to form an opinion of these individuals.

Teacher concerns over innovation are generally those of a personal nature as indicated in the CBAM framework of change. In a study of 17 teachers in a project in Southwest United States, a CBAM model was used to determine teacher concerns in the early stages of a one to one laptop program (Donovan et al., 2007). While a small study with limitations toward a larger population, the study was consistent with previous innovation adoption research (Hall & Hord, 2001) and showed that concerns are reported in one to one laptop programs when teachers are asked to change their teaching methods to use the laptops effectively (Penuel, 2006). The SoC portion of the study consisted of a questionnaire on a Likert type scale and open-ended questions to gather the data to be applied to the CBAM stages of adoption. Findings were that teachers had significant concerns about the impact of the laptop program on them as individuals and how the program impacted their professional duties (planning, time, and instructional practices). The second most prevalent stage of concerns was from a smaller group of teachers about to best use the laptops for teaching, teacher effectiveness, and collaboration with peers.

From the Donovan study, three recommendations were made when implementing educational innovations. The first recommendation was an alignment of professional development to teacher concerns, thus leading to a differentiated model of professional development. A second recommendation suggested the inclusion of teacher voice in the innovation to be adopted. Teachers in the interviews expressed concerns of uncertainty of the program's sustainability leading to apprehension in investing large amounts of time to change curriculum and classroom practices. The final recommendation was to address education about the change process with stakeholders emphasizing that the innovation implementation was acknowledged as being a journey rather than an specific event to be accomplished (Donovan et al., 2007).

The role of technology and the importance of teachers to use its capabilities to develop and equip students with skills relevant for their future and their ability to join an educated workforce has also been the topic of many educators. The perils of not addressing these issues and potential solutions to the challenge are outlined in the report, "Tough Choices, Tough Times" (Tucker et al., 2007). While the breadth and complexity of the report is beyond the scope of this study, it outlined the need for a different approach to the skills addressed in American education. Frameworks of systems to address these 21st century skills have been developed in a national organization supported by the U.S. Department of Education and the business community (Partnership for 21st Century Skills, 2011). These skills include global awareness, innovation, leadership, critical thinking, collaboration, productivity, self-direction, ethics, communication, creativity, problem solving, and accountability.

Over 1000 educators were surveyed concerning the use of technology in K12 education and the ability of teachers to use it in a way that promotes these skills

(Grunwald, 2010a). The study, commissioned by Walden University, established baselines of technology use by grade level and subject matter of elementary and secondary teachers. Statistical analysis of the teacher sample used a Pearson's chi-square value of less than or equal to .05 and had a margin of error of plus or minus 3.5 percent at the 95 percent confidence level. A key finding was that there is a great difference in how infrequent and frequent users of technology teach skills designated as 21st century learning skills. Teachers were asked to rate the use of technology within their efforts to teach the skills. Frequent users reported a much greater emphasis on 21st century skills and view the importance of teaching those skills with technology significantly more than infrequent users.

An implication of this finding reinforces that the role of the teacher is a crucial aspect of harnessing the power of technology in the classroom. Although there is documentation that students are highly adept with technology and digital media, they are not necessarily adept at using that skill wisely or for learning objectives of schooling (Grunwald, 2010b).

Another key finding of this study by Grunwald was that years of teaching experience made little difference on the frequency of technology use in the classroom. The study also found that the design of the teacher's lesson was the main reason technology was not used in the classroom rather than access to technology. However, a review of the survey questions makes this finding suspect in regards to how a teacher would respond when teaching in a one to one laptop program. The question, "For each technology device that you use less than once a week, please indicate the primary reason why you don't use it more often." could possibly preclude the laptop as a tool used less than once a week in a one to one program where the laptop is considered a central learning tool and strategy.

In acknowledgement of teacher's roles as the crucial implementer of a one to one laptop initiative mandated by the school district, Dalgarno, (2009), paid particular attention to their involvement as a determining factor of positive results within such a program pertaining to their beliefs, attitudes, and practices in areas of implementation.

Teacher beliefs and perceptions in this case study of compulsory laptop programs in Canada were gathered in qualitative and quantitative methods in areas of levels of technology use, facilitation of change (leadership and professional development and resources), and inhibitors of change.

Dalgarno developed her essential question for study around models of change and the adoption of innovation in general and specifically in education. A relevant discussion of the steps of policy adoption pointed out the levels of implementation to be studied in this project. This discussion of curriculum adoption set forth by a policy toward complete implementation is helpful in framing the consideration of teachers' attitudes and beliefs toward the success of full implementation of compulsory laptop programs within their schools. Three adoption models that have been used in education were considered: the Concerns Based Adoption Model (CBAM) from the work of Hall and Hord, (2001), the Apple Classroom of Tomorrow's Evolution of Thought Practice from the work of Dwyer et al., (1990), and the Adopter Categorization Model based off the Diffusion of Innovation (Rogers, 2003).

After evaluation, Dalgarno chose the CBAM and Adopter Categorization Model to frame the study as they were perceived to be more adaptive for describing and categorizing teachers perceptions while the ACOT ETP was deemed to be more prescriptive and less about teacher voice in their beliefs for need in professional development. Tools included in Dalgano's study were a series of questions from the work of Hall and Hord, (2006) to determine SoC and two single items measures of the CBAM LoU and SoC adapted from the work of Knezek, Christensen, Miyashita, & Ropp, (2000).

The other frame of the Dalgarno study was around barriers to educational change. From Fullan, (2007), first and second order change was discussed with an extensive discussion of first and second order barriers of change examined. This examination is the basis for the development of a substantial part of the online survey instrument used in the study. This survey instrument was administered to 270 teachers in nine of the 87 Canadian schools with compulsory laptop programs to measure the levels of technology use and their perceptions of the laptop programs. Response rate was 32 % of the invited respondents. A follow-up focus group and interview was administered to 21 teachers after the survey. A case study of one school was done for a qualitative portion of this mixed methods research project.

One of Dalgarno's findings was that when teachers were left alone to interpret the vision and mission of the mandated laptop programs, their perceptions became emotive, and were not in line with administrative perceptions and goals. In addition, teacher implementation efforts did not always align with the intended focus of the projects, specifically due to the intended focus not being implicitly stated or communicated. Perceptions of mandated uses versus uses that would better make a difference in the delivery of learning activities brought discord among many respondents. Challenges of keeping equipment working as it aged, and providing the peripherals devices to utilize the full power of the laptop, were also viewed as barriers by the teachers. Barriers to implementation identified by the teacher were different than what was anticipated by the administration. The Dalgarno study indicated that by better understanding teacher beliefs, their needs could be better supported through more relevant teacher professional development activities, ongoing experiences with the laptops and changing technologies, and making better connection of the technology uses to pedagogy and curriculum.

2.5 Student Uses of Technology at School and at Home

The uses of technology by children at home are changing rapidly. In 2001-2002, report two of the fourteen part "Use, Support, and Effect of Instructional Technology" (USEIT) Study in Massachusetts studied home use of technology by children going to school in 22 school districts and determined use of computers at school and at home, home accessibility, frequency of use, types of applications and student beliefs (Russell et al., 2003b). In this study, over 14,000 students were surveyed in grades 5, 8, and 11. The access to technology varied at the schools but were not specified in the study so ratios of computers to students were not established, making for limited use in the study of a one to one laptop program with a dedicated machine per student. It does, however, provide a background of student use in a general sense.

The number of students reporting access to a home computer and Internet access was high with approximately 2% of the students at each grade level in the survey reported not having a computer at home with between 4 – 7% not having Internet.

The amount of time computers were used at school was significantly less than the time a computer was used at home. At school, 41% of 5th grade students reported they used their computer in their classroom, while 12% of 8th grade student and 7% of 11th grade student reported the same. 64% of 5th grade students reported they used the computer every day for 15 minutes or less, with 73% of grade 8 and 72% of grade 11 students reporting the same.

In contrast, 79% of students in grade 5 reported spending 15 or more minutes on the computer at home every day, while 90% of 8th grade students and 85% of 11th grade students reported the same. Not surprisingly, students reported they learned how to do new things on a computer at home at much higher rates than at school, 64%, 70.1% and 74.5% for students in grades 5, 8, and 11 respectfully. See Table 11 and 12.

Table 11:

USEIT student use of technology at home

Task: At home, how often do you use a computer to:	% Reporting Every day Use		
	Grade 5	Grade 8	Grade 11
Chat or Instant Message	25.3	58.7	55.0
Send and receive email	27.4	56.1	60.2
Find information on the Internet	29.3	53.8	58.5
Play computer games	44.7	38.7	25.8

Adapted from(Russell et al., 2003b)

Table 12:

USEIT student beliefs regarding using a computer in school

Task: At School: When using a computer for your school work, do you:	% Reporting Usually or Always		
	Grade 5	Grade 8	Grade 11
Create a better-looking finished product than if you didn't use a computer.	71	88	89
Write better?	63	75	69
Seem to understand better?	51	57	44
Work harder?	51	57	48

Adapted from (Russell et al., 2003b)

In a pair of studies, home and school use of technology were analyzed to see what effect technology use had upon standardized test scores in English and language arts and in mathematics and science of 4th grade students in 25 Massachusetts elementary schools (O'Dwyer, Russell, Bebell, & Tucker-Seeley, 2005; O'Dwyer, 2004; Russell, O'Dwyer, Bebell, & Tucker-Seeley, 2004). Both studies determined the frequencies of teacher and student use of technology at home and at school and performed a hierarchical regression analysis which nested students technology uses and English and math test scores respectively, their teacher characteristics of technology use and their school together to take into consideration variability between teachers, classrooms, and schools. By doing so, effect sizes of clustered and individual variables were determined on the standardized test scores. Both studies found that the most positive predictors of achievement on test scores were prior achievement and proxies for socioeconomic status, both unrelated to technology in these studies.

The use of computers at home and at school for editing papers was a positive indicator for improvement in reading and writing scores, while using a computer to create presentation or for recreation at home were negative predictors (O'Dwyer et al., 2005). The total variance of mean standardized test scores accounted for by variables pertaining to computer use was from 12% to 25%. All measures of student technology use in math showed no positive or negative relationship to test scores (Russell et al., 2004). Measures of teacher use of technology showed very small but significant relationships in several areas. The total variance of mean standardized test scores accounted for by variables pertaining to computer use was from 2 to 3%.

Of interest in the two studies are the levels of frequency that teachers and students reported using technology in their instruction or learning. One third of the math classrooms chosen for the study were considered "high use" classrooms. A "moderate" amount of teachers reported using technology several times a month to every week yet very few students reported using technology for math more than once per month and with many reporting never, or almost never (Russell et al., 2004). The mean for use of technology in instruction for English teachers was "several times a year" yet with many students reporting using technology in all categories of at-school use as never or almost never (O'Dwyer et al., 2005). What may be indicated by the two studies is that the teachers did not do what the title of the study series indicated (that is, "Use It").

In a one to one laptop-learning environment where students have access 24/7 in and out of school, teachers are not the only control of what and how learning is taking place. Students also have control over the amount of technology use in their learning. They, and their educational achievement, are also a primary impetus for any type of technology initiative. Therefore, when anytime, anywhere access is made available by the school, student levels of usage during and outside of school are important to understand.

Recent studies of young children indicate the change in use of computers, mobile devices and the internet. In a recent study, 95 % of all teens 12 - 17 now use internet, up from 87% in 2004, with 70% of those using the internet using daily, and 46% multiple times daily (Lenhart et al., 2011). 80% of teens were found to use social networking sites such as Facebook, MySpace, and Twitter, up from 55% in a 2006 survey, with 93% of the teens with an online presence having an account on Facebook.

What should make technology integration more urgent, and the use of technology a priority for educational leaders are reports of technology use by very young children. Seventy-two percent (72%) of all children have a computer in the home with 59% using them at least once daily, and 59% using them for educational purposes (Rideout & Saphir, 2011). Ten percent (10%) of children from age 0 – 8 years used a computer for educational software for an average of over one hour per day. Six percent (6%) of children age 0-8 year used a computer for homework for an average of 1:20 hours per day. The differences of having access to a computer and at home, and now an identified "app gap" were identified as issues between racial and socioeconomic groups. The term "app gap" is described as the difference in ability for children from different socioeconomic status in terms of using interactive educational "apps" on mobile devices (smartphones, tablet devices, iPod Touch devices) (Rideout & Saphir, 2011, p. 10).

In a study of young children ages 2 – 5 across 10 countries, 58% of those children could play a computer based game, 28% could place a cell phone call, and 69% could use a computer mouse to control a computer (Smith, 2010). As these students enter school and the use of technology in their learning accelerates, there is an urgency to have knowledge of how teachers use technology so that they, and school leadership, can lessen the gap of the use of technology in school versus student expectations.

2.6 Findings From Alaska One to One Research

As previously noted, studies of Alaska one to one programs have been slow to appear. To date, only three studies have been attempted. All three analyzed the impacts and effects of the Consortium for Digital Learning sponsored by the Alaska Association of School Boards, which initially supported 18 school districts in 2006 for one to one laptop pilots. In 2008, an additional 10 districts were added to the project. In total, over 100 school sites implemented one to one laptop programs in a variety of forms through this project. In 2008 (Edwin et al., 2009) conducted a mid-term report on the progress of the Consortium for Digital Learning Project which started in 2006. This report reviewed data sources from six of 18 school districts included in the project's first round of funding. Both qualitative and quantitative data was used. Baseline data for student achievement was used by using 2005/2006 data to establish the cohort and then using the State Standard Based Assessment for the two project years, 2006/2007 and 2007/2008. A School Climate and Connectedness Survey (SCCS), which measured overall school climate, was used to assess impacts on school environment for the two project years. Data from NCLB reporting was also used in areas of attendance and dropout rate. Educators in two of the sites were interviewed in the qualitative part of the study.

Non-matched cohorts of students were established by the grade and year they received the laptops. Scores in reading, writing, and mathematics were reported. The 9th grade cohort had only one year of data, as eleventh grade students did not take SBA's in 2007/2008. Schools reported SCCS data. This data was gathered by an anonymous survey to all students.

Student achievement and drop out rate was found to have no consistent pattern with some schools showing progress and others remaining the same or loosing ground. Small improvements in student and staff ratings of school climate and a decline in risky behavior were reported. Staff from the two communities reported transformational change in teaching and dramatic technology infusion in many classes.

Limitations of much of the research on the effect of technology on student learning have been identified in three areas of causality. These three areas are:

> (1) the way in which students' and teachers' technology use is measured, (2) measures of achievement that are not specifically designed to capture the types of improved learning that occurs as a result of technology use, and (3) reliance on either aggregate school level data or individual level data within classrooms which does not take into account differences within and between schools when modeling student outcomes. (O'Dwyer, 2004, p. 8)

Several significant limitations were identified by authors of the Edwin study that coincides with limitations stated by O'Dwyer. None of the data used in the Edwin study was designed to measure the impacts of the one to one initiative as stated in the goals of the project of readying students for a global economy or learning "21st century" skills (Edwin et al., 2009). Aggregated data for the SBA's and SCCS did not allow a focus upon the one to one students. The short time-line of a two-year implementation was also noted as a limitation due to the longer-term nature of accepted technology adoption. The complexity of the nature of the schools included in the study was also noted in that there were many reform efforts going on at the same time, and many mandates imposed on some of the schools by state and federal entities. Because the researchers were brought in mid-project, no baseline data other than SBA's for the grade level could be obtained, nor could changes in the student cohort be known.

One limitation that was perhaps understated was the inability to identify individuals within cohort groups. While transience was noted as a limitation, the researchers felt that they were "reasonably close" in ascertaining which students should be included in the cohort (Edwin et al., 2009). An examination of the transience rate of schools included in the study reveals that many of the schools in the districts had high transience during the study years of 2005/2007. This inability to know which students were included in the cohort lead to the possibility that students included in the SBA and SCCS surveys were in the one to one programs for brief time periods or that groups of students thought to be of the same cohort were actually different students. Table 13 demonstrates the transience of select schools within the study as reported by the Alaska Department of Education and Early Childhood (Alaska Department of Education and Early Childhood, 2011). Data that could establish how long a student was in the school and how long the student had been issued a laptop would help to alleviate this issue.

Table 13:

2005-2008 Transiency rate of sample Alaska schools

Transiency	2005-2006	2006-2007	2007-2008
District 1			
School 1	15.4	14.3	22.8
School 2	13.2	81.3	13.3
District 2			
School 1	24.0	35.5	11.2
School 2	28.0	5.0	20.0
School 3	43.0	27.3	44.4
District 4			
School 1	35.9	32.9	26.0
District 5			
School 1	26.3	28.9	22.6
School 2	11.8	16.7	10.1
District 5			
School 1	10.6	14.6	11.3

Developed from data of (Edwin et al., 2009) and (Alaska Department of Education and Early Childhood, 2011).

Mid-term and final reports were conducted by (Ohler, 2009, 2011) for the Consortium for Digital Learning. The mid-term report was a qualitative study to support the efforts of Edwin (2009) through a series of 10 interviews with select teachers, program managers and superintendents based upon the depth and breadth of the one to one deployment in their school district. Consistency by interviewees on the success and impact of the one to one programs were reported as "Overwhelming" (Ohler, 2009). Findings from the interviews supported the Edwin report in the area of student achievement with mixed or flat results with slight increases in writing on standardized tests scores. Student engagement was reported to have increased as were dramatically decreased discipline issues, supporting the findings of a decline in risky behavior reported by Edwin.

Other themes coming from this mid-term report were that teachers grew in their approach to digital learning toward a more student-centered approach. Challenges within the one to one programs were viewed as positive challenges, for example, the need of more of what had worked. More professional development, support, and resources were indicated as participants had seen success when these items were present. Challenges were also reported in the areas of school culture and geography with a difference in rural and more urban districts cited in areas of transience of teachers and challenges to professional development.

The final report of the CDL initiative built upon the first report by going back to the interviewees in the mid-term report with a longer set of questions, but including the same questions as a year and a half earlier (Ohler, 2011). In addition, three case studies of individual teachers were included as examples of teaching strategies employed pre/post one to one implementation. The responses to the interviews were reported to be very consistent and when synthesized, could be refined into eight key findings. These findings included: (a) state standardized test scores remained flat, and student engagement measures, digital expression and preparation for the digital culture beyond school were improved, (b) a return to technology and pedagogy prior to the one to one laptop program was not considered a possibility by teachers, (c) linking the use of computers solely to state test scores ignored the need for skills needed by students for a digital economy, (d) the Consortium for Digital Learning was considered crucial to schools success of implementation, (e) professional development played a crucial role in any successes of the project, (f) most schools had found ways to incrementally expand their programs, (g) sustainability of funding was a main concern of schools, and (h) schools considered themselves fortunate to be part of a minority of schools in the state which could participate in the one to one project (Ohler, 2011).

The response consistency from individual to individual over a period of years lends added credibility to the Ohler reports. An expansion of the final report to deepen the understanding of previous questions and to better understand participant concerns about the program is useful in understanding the movement of adoption of the one to one over time. If applied to the CBAM framework previously outlined, this movement would be described as movement from Stage 4 Consequence to Stage 5 Collaboration moving, into Stage 6 Refocusing. The limited number of interviewees and districts within the CDL program could lead to selection bias. While it is tempting to generalize the findings of a qualitative study such as the Ohler report, the intent of such a study is not to generalize findings to individuals, sites, or places outside of those under study but to provide identify themes within the context of the entities included in the study (Creswell, 2009, pp. 192-193).

2.7 Summary

This chapter has provided a background to understand the nature of one to one laptop computing and the direction of this study. The scale of implementation in Alaska for one to one projects has been one that engages many school districts across a broad geographic area, and many schools that have unique characteristics. The magnitude of this scale also includes many complexities of schooling at the local level, representing fundamental change in many cases. The use of these frameworks within this study is useful to determine levels of use by teachers and to help validate measures of expertise and technology use. The review of literature outlined frameworks of change that lead to adoption of a new innovation, in this case, the one to one laptop program.

This review also gives background on the research of important issues within the context of a one to one laptop program: (a) evidence from major studies of multi-district implementations; (b) the role of the teacher and the beliefs and practices they bring to any new educational innovation, especially a one to one computing initiative; and (c) how students currently use technology in and out of school. Large scale multiple district implementations in the last decade in the United States were highlighted to build a knowledge base of efforts made in similar fashions as Alaska's one to one implementation efforts and the results of those programs. A review of teacher and student roles in the use of technology within one to one laptops programs and in their personal life gives background regarding levels of use and outcomes from the use of technology in professional practice and the classroom. Finally a review of the few studies done in Alaska regarding the one to one laptop programs helps to provide the context of the research environment in Alaska and the need of the information provided by this study and the studies of the Tech Cohort.

Chapter 3: Methodology

3.1 Research Questions

The research question forming the basis of this study is "What are the levels of use of technology and technology proficiency comprising the Level of Adoption (LoA) of students and teachers and the quantitative skills, dispositions and attitudes, and roles of teachers assumed inside and outside the educational setting within existing Alaska one to one high school laptop programs within various subgroups?" Additional questions that support the main research questions are:

1) How do teacher perceptions of their technology use in the classroom vary based on teacher demographics?

- Null hypothesis: H_0: There is no difference between the identified independent variables of demographic data and the teacher use of technology in personal life.
- Alternate hypothesis: H_1: There is significant difference between the identified independent variables of demographic data and the teacher use of technology in personal life.
- Null hypothesis: H_o: There is no difference between the identified independent variables of demographic data and the teacher use of technology in professional practice.
- Alternate hypothesis: H_1: There is significant difference between the identified independent variables of demographic data and the teacher use of technology in professional practice.
- Null hypothesis: H_o: There is no difference between the identified independent variables of demographic data and the teacher use of technology in classroom use.
- Alternate hypothesis: H_1: There is significant difference between the identified independent variables of demographic data and the teacher use of technology in classroom use.

2) Do teachers' perceived levels of uses in their personal and/or professional practice lives relate to levels of technology uses in the classroom.

- Null hypothesis: H_o: There is no significant difference between mean scores of indices of teacher use of technology in personal life versus professional practice.

- Alternative hypothesis: H_1: There is significant difference between mean scores of indices of teacher use of technology in personal life versus professional practice.
- Null hypothesis: H_0: There is no significant difference between mean scores of indices of teacher use of technology in personal life versus classroom use.
- Alternate hypothesis: H_1 There is significant difference between mean scores of indices of teacher use of technology in personal life versus classroom use due to barriers encountered within the classroom.
- Null hypothesis: H_0: There is no significant difference between mean scores of indices of teacher use of technology in professional practice versus classroom use.
- Alternate hypothesis: H_1: There is a significant difference between mean scores of indices of teacher use of technology in professional practice versus classroom use.

3) What is the level of adoption of the one to one laptop as measured by the Concerns Based Adoption Model?

4) How are students and teachers use technology for personal use and classroom use?

5) What are teacher perceptions regarding the implementation of technology in one to one laptop programs?

3.2 Theoretical Lens

A number of characteristics of the pragmatic viewpoint seemed to fit the research and questions of this study. The pragmatic viewpoint recognizes that researchers have a "freedom of choice" to choose methods and procedures that best meet the needs and purposes of the study and that "research always occurs in social, historical, and political contexts" (Creswell, 2009, p. 4). Given the scope of this study, it was necessary to take into consideration the vast geographical area in which the participants lived, the lack of economical transportation systems to get to the sites, the amount of time and money that would be necessary to undertake a study of high schools in Alaska, the need to have some freedom to choose methods, and recognition of the contexts in which the research was taking place.

The pragmatic worldview arises out of actions, situations, and consequences that opens the door to multiple methods the use of different worldviews and different assumptions, as well as different forms of data collection and analysis (Creswell, 2009). Due to the questions of this study and the need to provide a clear picture of the one to one landscape for policymakers who are developing, implementing, and sustaining these efforts, the ability to use strengths of multiple methods was chosen to bring about the most relevant information.

A fundamental principle of a mixed method approach is that different strategies and a combination of approaches in the collection of data results in strengths that complement each other and mitigate non-overlapping weaknesses (Johnson & Onwuegbuzie, 2004). This principle makes this mixed method approach very appealing for a study of this scope.

Schools are realities for children resulting from the actions and beliefs of the adults who design, develop and implement educational and social systems within them, and are institutions with many levels of complexity. In this instance, the pragmatic viewpoint allowed the freedom in this study to design methods that built upon the strengths of the cohort in terms of knowledge about the schools to be studied. It also built upon the rapport that the cohort had with the numerous school districts they worked within other capacities that were included in the study.

3.3 Control for Bias

The pragmatic approach is applicable to this study of the perceptions and concerns of teachers and students regarding use of technology in and out of school. Adding the strength of a post-positivist view seemed to be an important characteristic to consider, given the background and experience of this researcher as stated in Chapter 2. The regulatory goal of the post-positivist view to be objective in research should help in "reducing and controlling researcher bias through acknowledgement, emotional detachment and un-involvement from the data collection" (Johnson & Onwuegbuzie, 2004, p. 14). Decisions must still be made in this research study in regards to the focus and scope, development and refinement of instruments, interpretations, and conclusions. Given past involvement and energies devoted to the study, implementation and sustainability to one to one digital learning projects in Alaska and in the western United States explained in section 3.5, biases of the researcher are held in check with a study that uses quantitative data from previously developed instruments and methodology.

3.4 Methodology Choices

The framework advocated by Zucker, (2004) has implication with any study of levels of technology adoption and roles played by teachers within Alaska's one to one laptop programs. A concentration on impacts on teaching and instruction as well as students and their learning dominate the questions of this study, as many of the critical features of the Alaska one to one initiatives were generally known by the combined knowledge and expertise of our cohort in terms of (a) technology used, (b) program settings, (c) implementation plans, and (d) goals and objectives. Figure 6 shows the focus of this study within the Zucker Framework (Zucker, 2004).

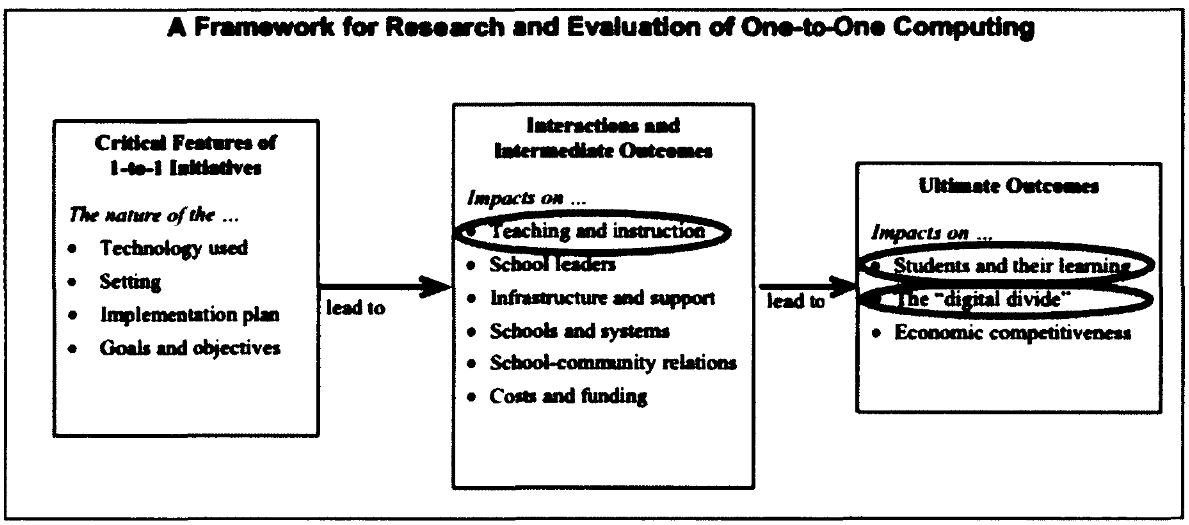

Figure 6. Focus of current study with Zucker Framework

3.5 Research Design

The lack of research and general knowledge of what is happening in the one to one laptop programs in Alaska, the nature of the participants, the familiarity of technology to them, the magnitude of the distances between school sites, and the lack of affordable transportation to sites, led to a descriptive mixed methods non-experimental study with a concurrent embedded design. The strategy of concurrent embedded design lends itself to several advantages including (a) the ability to gain broader and different perspectives as a result of using different methods rather than one predominant method alone, (b) the ability to gain a different level of analysis which could not be achieved with one single method, (c) the ability to collect two types of data simultaneously in a single data collection, and (d) the ability to mix the data to compare data sources or to compare the data side by side for two separate views providing a composite assessment (Creswell, 2009).

A descriptive approach will be used to relate findings in a two phase, concurrent explanatory study through analysis of primary quantitative survey research analysis of supporting qualitative open-ended items.

3.6 Context of the Researcher

The context of this study results from the researcher's ongoing personal involvement with the implementation of large-scale one to one laptop learning projects from conception, implementation and maturation of such projects to institutionalization. This involvement came from personal experience of designing and implementing such programs as a superintendent of schools of a one to one laptop environment in an Alaska school district for all students grades 6 through 12, and through a position of Education Development Executive for Apple, Inc. in thirteen western states for high access technology projects such as one to one.

3.7 Parameters of Research Population

Of the approximate 100 schools in Alaska that are currently pursuing one to one laptop learning programs in some manner, the majority of these projects are in rural or bush Alaska in small schools (Nelson, 2006). The Association of Alaska School Board's Consortium for Digital Learning (CDL) provided funding and support in 2006 for fifteen Alaska school districts in their one to one laptop program implementations, and sixteen new projects or expansion to existing programs were supported in 2008. During this time period, several districts found funding for one to one implementations on their own. Individual school districts chose the grade levels of implementation of their projects. The majority of these projects were high school implementations with some middle schools and a few elementary schools. Almost all of the one to one programs started in Alaska followed the "complete solution" model proposed by the CDL. This complete solution incorporated recommendations from Apple, Inc., based upon its experience in implementation of one to one programs across the country, and research and evaluations of large-scale implementations in Maine and Virginia. The solution set included an analysis and recommendations concerning the wireless network and electrical capabilities of the school, a common hardware platform, a common software package of productivity and creative software, a prescribed package of professional development and technical services, the development of an in-state repair depot to speed return of damaged equipment, and a reserve of spare computers per school to minimize downtime (Kelly, 2011). The schools within this study have similar hardware/software solutions and follow these guidelines for support services.

3.7.1 Delimitation of population sample.

The population of interest for this study was the high school implementations that met the "one to one" definition chosen by the Tech Cohort. The sample population for this study was chosen due to the fact that they comprised the majority of one to one implementations in Alaska. The definition of one to one for this study is derived from the recognition of efforts to provide a "complete solution" (Nelson, 2006). This complete solution supports critical components within each one to one program, and these components were readily present in all schools included in this study.

In order to determine the number of one to one laptop programs in Alaska's high schools, research was initiated with data from the CDL, as the vast majority of one to one laptop programs in Alaska are found within the programs initiated by the CDL. Additionally, the Tech Cohort was able to further update the number of one to one high schools by the use of personal surveys of school district employees in districts known to have one to one programs. The personal knowledge of our cohort, and information supplied by vendors, was also used to determine the numbers of programs.

The numbers of students for these schools were determined from the report of enrollment and grade for the school year 2010-2011 from the Alaska Department of Education and Early Development (Alaska Department of Education and Early

Childhood, 2011). Numbers of teachers in the schools were gained by gleaning the data from the Alaska Department of Education and Early Childhood Development Report Cards, individual school websites, personal contact with school administrations, and personal knowledge of the Tech Cohort.

Twenty-one school districts in Alaska met the above criteria. Using the methods described previously, an estimated total population of students and teachers in high school one to one laptop program was established to be 2639 students and 366 teachers for these school districts. Of the twenty-one districts, permission to conduct research was obtained from fifteen superintendents. Two of the districts and several schools within those districts that gave permission for the surveys had conflicts due to spring testing and end of year activities and did not administer the surveys. Survey respondents came from the remaining thirteen districts. The total study population was determined to be 2142 students and 291 teachers. See Figure 7 for list of school districts and population data.

AEBSD	9-12	16	75			Yes
BBSD	9-12	6	65			Yes
Cordova	7-9	4	25			Yes
Craig	9-12	13	83		X	
Denali	6-10	10	35		X	
Dillingham	9-12	12	155		X	
Haines	9-12	7	109			Yes
Iditarod	8-12	8	31	No		
Juneau	9-12	31	172			Yes
Klawock	9-12	8	45			Yes
Kashunamiut	9-12	9	82	No		
Kuspuk	9-12	13	98			Yes
Lake and Pen	9-12	3	12	No		
LKSD	8-10, 9-12	83	424			Yes
NSBSD	1-12	50	403			Yes
NWABSD	9-12	30	252			Yes
Petersburg	3-12	12	178			Yes
Pribilof	9-12	4	17	No		
SEISD	6-12	12	62	No		
SWRSD	6-12	17	182			Yes
Wrangell	9-12	14	114			Yes
Yukon Flats	6-12	4	20	No		
	Total Population	366	2639			
	Total Sample Population	291	2142			

Figure 7. Composition of sample population

3.8 Research Methods

The method of data collection for this research consisted of one quantitative online survey for teachers and one for students. The survey had both closed and open-ended questions. An online cross-sectional survey design using an internet survey instrument (Surveymonkey.com) was chosen as the preferred method for gathering the data with open-ended questions that supported the quantitative direction of the survey included at the end of the quantitative survey.

3.8.1 Expert review.

Communication with the developers of portions of the survey instrument included in this study were conducted with Metiri Group and Apple, Inc. in regards to teacher survey questions, survey construct, and data analysis of the Professional Technology Profile (PTP) survey tool. This tool measures teacher level of technology use and roles played using technology. Since the Tech Cohort agreed to use one online survey to gather data in one data collection for each population of teachers and students, each survey was designed to include data regarding each cohort research questions.

An interview with the Alaska State Technology Coordinator provided expert opinion on types of quantitative questions and open-ended questions to be included in the survey for both teachers and students (Mourant, 2011).

3.8.2 Web-based survey development and IRB approval.

The advantages of using web based surveys include a) the ability to mitigate distances involved and scheduling challenges with the data collection of specific identified sites, b) provide cost efficiency, c) quick data capture in a single collection window, d) recipient acceptance of format, and e) rapid turnaround of analysis (Granello & Wheaton, 2004; Wright, 2005). Each student and teacher in a one to one laptop program had their own laptop that makes this type of survey easier to administer and provides familiarity with the use of online tools. A single data collection was administered to mitigate impact on schools and to streamline the administration of the survey itself. The survey tools for both teachers and students were designed to gather information for three of the Tech Cohort's studies. Questions from the teacher survey tool were used by all four of the Tech Cohort members. Questions of the student survey tool were used primarily by three of the cohort. Questions of the online survey were consolidated into sections pertaining to individual researcher's questions. A spring administration of the survey was chosen for teachers and students to reflect on practices undertaken throughout the school year.

Each survey instrument was reviewed by the Tech Cohort for relevance to Alaska school and village environments so that terms used within it were culturally responsive. The survey instruments were submitted to IRB and approved for administration on Dec. 21, 2010.

3.8.3 Teacher survey tool.

Written permission to use the existing survey instrument (PTP) from the work of Lemke, (2009) was obtained from the owner (Apple Professional Development) to determine levels of technology use and roles of teachers. Permission included all aspects of use of the instrument including use of documentation of the design, weighting of questions, and scoring of the instrument. This survey design served as a basis for two nationally administered surveys for Consortium of School Networking Leadership Initiative (Lemke, 2011).

Written permission was granted by the author of a similar research study for use of an instrument using the CBAM framework regarding teacher concerns about the implementation of a compulsory laptop program (Dalgarno, 2009). These were also modified for relevance to Alaska school and village environments and combined into one survey instrument for teachers.

The teacher's survey was divided into six areas:

1) Section One was ten questions with ten total items. Demographics of each individual were gathered in one section of the survey including school location, gender, age, ethnicity, tenure teaching, tenure teaching in the state, teaching in a one to one laptop program, professional development exposure, subjects taught, and perceptions of technology proficiency.

2) Sections Two and Three contained ten questions with ten total items. Questions regarded computer and Internet access at home and school.

3) Section Four was comprised of three questions with three total items. Questions regarding teacher professional development opportunities and preferences were asked. Section Five, Six and Eight contained eight questions with 103 total items. Data was gathered using a multi-stage design of questions using a single answer, multiple answer and a five-point Likert-like scale to determine levels of congruence when reporting levels of usage in personal, professional, classroom use of technology, and student use of technology in learning activities as well as attitudes and beliefs toward the use of technology.

Level of Adoption (LoA) was determined by frequencies of technology use and levels of technology proficiencies. For teachers and students, this was done by modifying the Personal Technology Profile (PTP) from the work of (Lemke, 2009). According to the protocol established for the PTP, indices were developed from the collected data by combining related questions to specific categories of personal use of technology, technology use for professional practice (including professional development), and classroom use of technology. LoA will be determined in each of three categories, Total Personal Use (TPU), Total Professional Practice (TPP), Total Classroom Use (TCU).

The PTP was adapted because its intent was to provide a personal profile within the defined roles. The adaption made in our study was to develop an index of technology adoption within each role as well as a total technology index in each category of personal, professional, and classroom use. The establishment of a total index with each role meant that the scoring system by which the PTP was developed needed to have a better method to accurately place index scores within equidistant ranges for valid analysis.

The LoA indices were constructed by using a combination of weighted questions regarding three categories of use (Personal Use, Professional Practice, and Classroom Use) and in six roles within each category (Change Agent, Communicator/Connector, Producer, Implementer, Contributor, Consumer). Questions are related to either frequency, or expertise (proficiency). Questions based on a 5-point Likert scale were asked about frequency of use of applications using responses (Never, Rarely, Occasionally, Fairly often, Very often), kinds of use and situations using (Not like me, A little like me, Somewhat like me, A lot like me, Exactly like me), types of preferred learning styles using a scale (1- Low, 5- High), and expertise in using technology to advance student learning using the responses (NA or No expertise, Novice, Intermediate, Expert, and Advanced).

Weighting of each question within each role was determined by the complexity needed to use the technology, the length of time the technology has been available, and its level of adoption in the general public into consideration. Three separate categories of complexity were used from the (Lemke, 2009) study: low, moderate, and high. (low using 1, 3, 5, 6, 7; moderate using 1, 4, 6, 8, 10; and high using 1, 5, 8, 10, 12) based on the Metiri scoring guide.

An index percentage for each of the roles within each of TPP, TPU, and TCU was established. Each index was created by totaling the weighted score and dividing the total score by the total points possible to determine the percentage. The different role percentages were then averaged together to get TPU, TPP, and TCU. The range of adoption within each role defined the levels of use through LoA based on the complexity of the questions that made up each of the roles by dividing the scores into four quartiles showing levels of use from 1 - 4 representing low levels use to high levels of use.

Table 14 indicates the scoring system used for the establishment of levels of adoption.

Table 14:

Ranges of levels of adoption (LoA of the PTP

Level One	0.00% - 24.99%
Level Two	25.00% - 49.99%
Level Three	50.00% - 74.99%
Level Four	75.00% - 100%

Table 15 demonstrates the questions and calculations used for each role and total indices.

Table 15:

Questions for indices of teacher use of technology

Roles Teachers Assume When Using Technology	
Personal Use (TPU)	Questions regarding each role
Change Agent (CA)	6.2.1, 6.2.2, 6.2.3
Connector/Communicator (CC)	6.1.1, 6.1.5, 6.1.11, 6.2.4, 6.2.5, 6.2.11
Contributor (C)	6.1.2, 6.1.3, 6.1.4, 6.1.8, 6.2.6, 6.2.7
Producer (P)	6.1.6, 6.1.7, 6.1.10
Consumer (CO)	6.1.9, 6.1.12, 6.1.13, 6.2.9, 6.2.12
Professional Practice (TPP)	Questions regarding each role
Change Agent (CA)	7.4.1, 7.4.2, 7.4.3, 7.4.4, 7.4.16, 7.4.19, 7.4.20, 7.4.21, 7.5.1, 7.5.5, 7.5.8
Connector/Communicator (CC)	7.1.1, 7.1.4, 7.4.11, 7.4.5, 7.4.6, 7.4.7, 7.4.8, 7.4.9, 7.5.6
Contributor (C)	7.1.2, 7.1.3, 7.1.8, 7.4.10, 7.4.11, 7.4.12
Implementer (I)	7.3.1, 7.3.2, 7.3.3, 7.3.4, 7.3.5, 7.4.17, 7.4.18
Producer (P)	7.1.6, 7.1.7, 7.1.10, 7.4.13, 7.4.14, 7.5.2, 7.5.3, 7.5.4, 7.5.7
Consumer (CO)	7.1.9, 7.1.12, 7.1.13, 7.2.1, 7.2.2, 7.2.3, 7.4.15
Classroom Use (TCU)	Questions regarding each role
Change Agent (CA)	9.1.12, 9.1.13, 9.1.20,9.1.23
Connector/Communicator (CC)	9.1.9, 9.1.10, 9.1.19
Contributor (C)	9.1.16, 9.1.17, 9.1.18
Implementer (I)	9.1.4, 9.1.5, 9.1.6, 9.1.11
Producer (P)	9.1.7, 9.1.8, 9.1.14, 9.1.15, 9.1.21, 9.1.22
Consumer (CO)	9.1.1, 9.1.2, 9.1.3

4) Section Seven contained eleven questions with 39 total items. This section was designed to gain information regarding the teacher's perception of their teaching style and philosophy and use of technology using a survey from the national study "Teaching, Learning, and Computing: 1998" (Becker, Ravitz, & Wong, 2000). This survey section was used in another study within the Tech Cohort (LeDoux, 2012)

5) Section Eight was six questions containing 38 total items. Section eight of the teacher survey tool included questions regarding ranking along frameworks of the CBAM and the SAMR Technology Adoption Cycle (Hall & Hord, 2001; Puentedura, 2008; Rogers, 2003). The SoC and LoU portion of the CBAM process from Knezek et al., (2000) was also included in this section. Questions regarding teacher concerns about change and their laptop program, critical components of the laptop program implementation, and their perceptions of their own abilities of technology use were

included in the Likert-type survey questions. These questions directly corresponded with the suggested protocol for LoU by (Hall, George, & Rutherford, 1977).

6) Section Nine contained eight questions with eight total items. Section nine included qualitative measures in terms of open ended questions, including those prescribed for the SoC of the CBAM (Hall & Hord, 2001). These questions were to allow teachers to voice any other concerns they might have concerning their laptop initiative, technology issues, or to share their thoughts on challenges and accomplishments of their technology implementation.

3.8.4 Student survey tool.

The student survey instrument was adapted from the teacher survey and created in a parallel fashion in order to be able to draw inferences between student and teacher answers to questions. Modifications in wording and reading level were made on the Lemke, (2009) PTP instrument asking questions regarding personal and school use of technology. The student survey was divided into five areas.

1) Section One contained nine Questions with a total of 23 items. Demographics of each individual were gathered in this section of the survey including school location, gender, grade, age, ethnicity, number of years at current school, number of years having a school issued laptop, school subjects that require Internet use, perception of technology proficiency.

2) Sections Two and Three was 11 questions with 11 total items and was comprised of questions regarding computer and Internet access at home and school.

3) Section Four was three questions with 26 total items. The questions pertained to student personal practice and paralleled the questions regarding teacher personal use. An additional question regarding the number of digital tools owned was also included.

4) Section Five contained four questions with 41 total items. A multi-stage design of questions using a single answer, multiple answers and a five point Likert-like scale were included in this section. Using the same protocol as the teacher survey, indices were developed from the gathered data by combining related questions to specific categories of personal use and classroom use of technology. Levels of adoption of technology (LoA) is

ranked on a scale, grouping individuals into one of four levels: Level One, Level Two, Level Three, and Level Four.

5) Section Six was comprised of three questions with three total items. Open-ended questions were included to allow students to voice additional thoughts on challenges and accomplishments of their technology implementation.

3.8.5 Pilot Study.

A comprehensive pilot study was administered in December 2010 and February 2011 to address validity and reliability. Internal reliability of the instrument and the feasibility and logistics of a single survey administration for data collection were goals of the pilot. Sequential administrations of the entire survey instrument were administered in two sites for the student survey and three sites for the teacher survey. The entire instrument was administered to test the length of the survey and responses to it. A member of our cohort was present for the administration of the survey in the first site and listened to a focus group of teachers afterward to gather information regarding the nature and structure of the survey. From this pilot focus group, adjustments were made for its second administration. Sections of the questions were shortened in both the teacher and student survey and presented in a more understandable nature. Wording for the student survey was also analyzed a second time with no changes being made. The concept learned from the first administration of having an onsite assistant during the survey period was incorporated into our procedure by gaining the help of the school district personnel in each school district.

3.8.6 Establishment of validity and reliability.

Validity was established in several ways. The structure of the data tools considered outside expert perspectives and these perspectives also influenced the design and administration of the pilot study. Through this expert review described in section 3.7.1, content validity was substantially confirmed.

3.8.7 Control of researcher bias.

The professional roles of the cohort researchers were used in positive development of the research design. Members of the Tech Cohort include the director of educational sales for a large internet service provider; a former commissioner of education for the State of Alaska; the CEO of an education non-profit; and the director of the Consortium for Digital Learning for Association of Alaska School Boards, formerly from Apple, Inc. Each member of the cohort is actively engaged in change in Alaska education and involved at a myriad of levels of the educational communities. Each, in their own right, is viewed as an expert in the field of education, leadership, and educational technology. Each member of the cohort brought his or her individual biases to any research study, filtering knowledge through the lens of perception and understanding. These biases influenced the design of this study; the way data is collected and analyzed, understood and interpreted. However, due to the independent nature of the cohort, each member was held in check by the others to temper biases he/she might exude at the moment.

Separate portions of the survey instrument were developed by reputable research associations and/or used in previous studies with measures of internal validity already established, as mentioned in section 3.7.7. Redundancy of the types of information requested from respondents was also built into the surveys to assure internal reliability of the instrument. While validity of the instrument needs to be established with the data gathered from this study, the results from the different methods used to design the survey instrument establish a comparison point for the validity and reliability of this particular tool.

3.8.8 Survey internal reliability.

Chronbach's alpha was used to analyze reliability for questions in the development of scales regarding teacher roles in personal use, professional practice, classroom use of technology, stages of concern within CBAM, and indices for student personal and classroom use of technology. Items with internal consistency below .70 are questionable and will not be used in analysis (Creswell, 2009). The internal consistency of the items included in each index of teacher use of technology is provided in Tables 16.

Table 16:

Alpha for indices of teachers use of technology

Roles Teachers Assume When Using Technology					
Personal Use (TPU)	Chronbach Alpha	Professional Practice (TPP)	Chronbach Alpha	Classroom Use (TCU)	Chronbach Alpha
Change Agent (CA)	.805	Change Agent (CA)	.884	Change Agent (CA)	.782
Connector/ Communicator (CC)	.730	Connector/ Communicator (CC)	.855	Connector/ Communicator (CC)	.750
Contributor (C)	.732	Contributor (C)	.738	Contributor (C)	.956
Producer (P)	.708	Implementer (I)	.792	Implementer (I)	.801
Consumer (CO)	.335	Producer (P)	.811	Producer (P)	.879
		Consumer (CO)	.766	Consumer (CO)	.629

Adapted from (Lemke, 2009)

The questions for measuring teacher concerns were grouped according to the SoC questionnaire manual (Hall et al., 1977). In the manual, estimates for internal consistency were indicated to range from .64 to .83, with six of the seven coefficients being above .70. The range for this study was from .616 to .886, with 2 of 5 being above .70. Table 17 indicates the alpha for each stage of concern.

Table 17:

Alpha for Stage of Concern indices

Type of Concern	Stages of Concern	Applicable Questions	Chronbach Alpha
Unrelated	0. Awareness	9.4.12, 9.6.6, 9.4.7	.293
Self	1. Informational	9.4.3, 9.4.8, 9.6.11	.616
	2. Personal	9.6.9	
Task	3. Management	9.4.4, 9.4.9, 9.6.3, 9.6.10	.629
	4. Consequence	9.4.6, 9.4.11, 9.6.2, 9.6.8	.752
	5. Collaboration	9.4.2, 9.4.5, 9.4.10, 9.6.4, 9.6.5	.886
	6. Refocusing	9.4.1, 9.6.1, 9.6.7	.679

Adapted from (Hall et al., 1977).

The reliability of the measure of Stages of Adoption from (Knezek et al., 2000) could not be measured as it is a single item; however, a high test-retest reliability of .91 was previously determined in research performed in a Texas study of 525 teachers (Knezek & Christensen, 2000).

Internal reliability for student indices in total personal use and classroom use of technology is reported in Table 18.

Table 18: *Alpha for student total use indices*		
Roles Students Assume When Using Technology		
Personal Use (SPU)	Questions regarding each role	Chronbach Alpha
Total SPU	All Questions	.881
Classroom Use (TCU)	Questions regarding each role	Chronbach Alpha
Total SCU	All Questions	.914

3.8.9 Response rate.

Informed consent was obtained from all respondents through the school district and with an informed consent page added to each survey. The respondents also had the option to leave the survey at any time if they did not wish to continue. Administration of the teacher survey was done in a self-administered, cross referenced manner within a data collection time window, with incentives established in the form of a drawing for a prize for those who completed and submitted their survey. The student survey was administered during school time under supervision of an adult during one class period chosen by the teacher. Both surveys were administered online through surveymonkey.com for an open period of April 15 until June 1, 2011. 115 teachers and 797 students submitted the survey.

A total of 27 teachers and 72 students started, but did not complete the surveys. These participants were omitted due to critical data being omitted, the input of deliberate inaccuracies, or because they were not qualified to respond (i.e. administrators who did not teach). The non-response rate was calculated to be 22.3% for teachers and 9% for students. After cleaning the data for participants that did not complete critical sections of the survey, and deleting those participants whose answers indicated non-cooperation by filling out the same answer throughout the whole survey, 94 teacher responses and 725 student responses were determined for the study. Response rate is defined as "the percentage of the potential respondents who were initially contacted and completed the questionnaire (Rea & Parker, 2005). After cleaning the data, the return rate was 40.0% for teachers and 43.0% for students.

Nominal, proportional and interval scale variables are present within the surveys.

The formula for establishing sample size and confidence levels for small populations to calculate an overall corresponding confidence levels and confidence intervals for the sample size of 94 teacher respondents is indicated by (Rea & Parker, 2005, p. 148). The formula is represented by the following equation:

The resulting teacher sample size results in a 95% confidence level ±.08%. For students, a sample size of 725 respondents results in a 95% confidence levels ± .03%. These calculations of margins of error generally satisfy the most stringent requirement of the interval scale variables (Rea & Parker, 2005).

3.9 Analysis of Quantitative Data

This section aligns the questions of the survey pertaining to the quantitative data to the research questions to be answered. Quantitative analysis was conducted using IBM SPSS version 19 software. Data was analyzed using descriptive crosstabs to identify frequency and percentage distributions, and analysis of variance (ANOVA), correlation and regression for continuous data to provide an understanding of the differences in personal and classroom use levels of adoption for teachers and students. In addition, descriptive statistics were used to provide a more complete picture for the research and to provide supportive detail for the investigative questions below.

Additional questions to explore that support/enlighten the overarching question of, "What are the levels of adoption (LoA) of technology of students and teachers and the quantitative skills, dispositions and attitudes and roles of teachers assumed inside and outside the educational setting within existing Alaska one to one high school laptop programs within various subgroups?" are:

- Question one: How do teacher perceptions of their technology use in the classroom vary based on teacher demographics? Descriptive analysis of the data generated central tendencies and standard deviation for demographic data and questions on professional development in sections one and four of the teacher survey. These PTP ranges are used in the analysis to determine variance of means between eight independent variables of demographic items. These variables are (a) age, (b) ethnicity, (c) total years teaching, (d) years teaching in Alaska, (e) years teaching at current school, (f) number of years in laptop program, (g) number of professional development hours provided by district, and (h) number of professional development hours outside of school.

- Question two: Do teachers' levels of uses in their personal life and professional practice affect the types of technology uses in the classroom? The development of indices for teacher categories of personal use, professional practice, and classroom use were determined by the scaling of weighted questions within the PTP survey questions. A technical scoring guide for the portion of the survey used to determine the levels of uses and roles of teachers was used to establish the indices. The compositions of the PTP indices of teacher expertise and their relationships to measures of teacher roles are listed in Table 19.

Table 19:

Composition of teacher use indices

TPU: Teacher Personal Use Index = CA+CC+C+P+CO/Total Points*100	
TPP: Teacher Professional Practice Index = CA+CC+C+I+P+CO/Total Points*100	
TCU: Teacher Classroom Use Index = CA+CC+C+I+P+CO/Total Points*100	
Key: CA - change agent index	CC - connector/communicator index
C - contributor index	I - implementer index
P - Producer index	CO - consumer index

These measured percentages were translated into the range of expertise (LoA) within each role.

- Question three: What is the level of adoption of the one to one laptop as measured by the Concerns Based Adoption Model? A total index for the SoC of teacher concern in regards to the one to one laptop implementation shows the level of adoption of the laptop programs as described in Hall et al., (1977). In addition, this SoC index compares means of the data gathered regarding self perception of technology use according to other frameworks included in the study (Hall & Hord, 2001; Puentedura, 2008; Rogers, 2003). A LoU (Levels of Use) profile are calculated from an individual question replicating work of Dalgarno, (2009). Supporting open-ended questions are coded toward aspects of the CBAM.

- Question four: How do students and teachers use technology differ in personal use and classroom use? Frequencies and measures of central tendency will be analyzed for each population in different subject areas and for types of technology use from demographic data in sections one and nine of the teacher and sections one and six of the student survey.
- Question five: What are teacher perceptions regarding the implementation of technology in one to one laptop programs? Descriptive analysis of questions in section 8 will include frequencies and measures of central tendency.

Table 20 defines the categories, corresponding questions in the survey and treatment for each question of the study.

Table 20:

Alpha for indices of teachers use of technology

Categories of variables	Corresponding Questions Survey	Treatment
1. How do teacher perceptions of their technology use in the classroom vary based on teacher demographics?		
Categories of variables	Corresponding Questions Survey	Treatment
Age, Ethnicity, Tenure teaching, Tenure teaching in the state and at current school, Teaching in a one to one laptop program, Perceptions of technology proficiency. Professional development exposure, Subjects taught, and Stages of Concern and Levels of Use.	TS Section 2: Questions 1 - 11 on Demographics TS Section 5: Questions 1 - 3 on Professional development TS Section 9: Questions 4 & 6 on Concerns of program TS Section 9: Question 7 on Concerns of Implementation TS questions: D#10, TCU 2, TCU3, TCU5 on Placement on Frameworks	Descriptive Statistics – Frequencies and Measures of Central Tendency ANOVA with single independent variables and indexes and Univariate linear model between professional development, years at current school and TCU
2. Do teachers levels of uses in their personal and professional practice life affect the types of technology uses in the classroom?		
Indices for TPU, TPP, and TCU	TS Sections 6, 7 and 9	ANOVA of total TPU and total TPP to total TCU Correlation and regression analysis of both total indices and LoA ranges.
3. What is the level of adoption of the one to one laptop as measured by the Concerns Based Adoption Model?		
Indices for Stages of Concern (SoC) and indicators of Levels of Use (LoU)	TS Section 9.2 – 9.6	Descriptives analysis and ANOVA of SoU indices and LoU indicators
4. How are students and teachers use technology for personal use and classroom use?		
Individual questions of SPU,	TS and SS Section 5: Question 1 and 2 on Personal Use TS and SS Section 6: Question 1 on School Use	Descriptive Statistics – Frequencies
5. What are perceptions from teachers regarding use of technology in one to one laptop programs?		
SoC Indices Implementation Questions	TS Section 9: Questions 4 & 6 on Concerns of program TS Section 9: Question 7 on Concerns of Implementation	Frequencies and Measures of Central Tendency - Indices of concerns
Table Key: TS = Teacher Survey TPU = Teacher Personal Use	TPP = Teacher Professional Practice TCU = Teacher Classroom Use SCU - Student Classroom Use	SSS = Student Survey SPU = Student Personal Use

3.10 Analysis of Qualitative Data

Open-ended questions will be coded for the presence of themes to support quantitative data from the survey. A question was provided to a cohort member for use in focus group in a subset of schools and will be included in this thematic coding. Open-ended questions supporting the heart of the information gained from the quantitative survey data will be coded into themes by the researcher using an open coding technique and a content analysis when appropriate as defined in Kvale & Brinkman, (2009). Open-coding was accomplished "by breaking down, examining, comparing, conceptualizing and categorizing" the data (Kvale & Brinkman, 2009, p. 202). Content analysis was accomplished by taking the categories from theories presented in this research in areas of the SoC indice framework, LoU (survey questions 9.2), and Stages of Adoption (survey question 9.5). Themes and codes were reviewed before and after coding by members of the Tech Cohort for inter-rater reliability. The ideas generated from the themes from the open-ended questions will be combined with, and aligned to, the quantitative data for deeper understanding.

3.11 Summary

This chapter summarizes the research design and methods of this study. This study attempts to bring light to five questions using quantitative and qualitative data concurrent in a complementary manner. Chapter 4 presents the results from the data analysis.

Chapter 4: Results

The following chapter will present the results of the quantitative and qualitative analysis of data on teachers and students technology use in an Alaska one to one laptop program across multiple school districts. Results came from the online survey designed by and administered by the Tech Cohort. This chapter is presented in five sections corresponding to the quantitative and qualitative analysis of each research question.

4.1 Research Questions and Findings

4.1.1 Research question one.

Demographic profiles and analysis of levels of teacher proficiency provide insight into research question one: "How do teacher perceptions of their technology use in the classroom vary based on teacher demographics?" Categories of demographic information were collected to describe the makeup of teachers participating in one to one laptop programs in the sample of schools in this study. Gender, age, ethnicity, total years teaching, total years teaching in Alaska, years teaching in the current school, years teaching in a one to one learning environment, and perceived level of proficiency were included in the demographic data. An average teacher in our sample was either male or female, Caucasian, either in their 30's or 50's, having taught 11 or more years, with over six years in Alaska, and three or more years at the same school; and in a laptop program for the same duration. The average teacher considered himself/herself to be "experienced" in their adoption of technology.

While this characterization is of the average respondent of teacher, a deeper analysis reveals a more detailed description of our sampling. The makeup of the teacher sample (n=94) shows an approximate equal representation in gender with 53.2% male and 46.8% female.

The two age groups most represented were the 50 – 59 group and the 30 – 39 group with 30.9% of the sample population residing within them both. Table 21 presents frequencies and percentages of age groupings by gender.

Table 21:

Age Groups by Gender

Age Groups	Male				Female			Totals	
	N	% of Males	% of total N		N	% of Females	% of total N	Total N	Total %
20-29	8	16%	8.6%		5	11.4%	5.4%	13	13.8%
30-39	13	26%	13.8%		16	36.4%	17.0%	29	30.9%
40-49	7	14%	7.4%		8	18.2%	8.5%	15	16.0%
50-59	16	32%	17.0%		13	29.5%	13.8%	29	30.9%
60 or older	6	12%	6.4%		2	4.6%	2.1%	8	8.5%
Total N	50	100%	53.2%		44	100%	46.8%	94	100.0%

85.1% of respondents were Caucasian, with the next two ethnic groups represented as Other at 8.5% and Alaska Native at 4.3%. Table 22 presents ethnicity groupings.

Table 22:

Ethnicity Frequencies of Teacher Sample

Ethnicity		
	Frequency	Total %
White	80	85.1%
Black or African American	1	1.1%
Hispanic/Latino	1	1.1%
Alaska Native/American Indian	4	4.3%
Other not listed	8	8.5%
Total N	94	100.0%

54.3% of respondents had taught 11 years or more with the 2nd most prevalent experience level at 1-5 years at 22.3% of respondents. Table 23 presents teachers experience levels represented in this sample.

Table 23:

Teacher Total Years Teaching

Total Yrs Teaching		
	Frequency	Total %
Less than 1 year	5	5.3%
1 - 5 years	21	22.3%
6-10 years	17	18.1%
11 or more years	51	54.3%
Total N	94	100.0%

The largest group of teachers reporting their experience teaching in Alaska was the group with 11 or more years experience (33.0%) with the group with 2-5 years of experience (26.6%) being the second largest representation. Table 24 represents the sample's Alaskan teaching experience.

Table 24:

Teacher Total Years Taught in Alaska

Yrs Taught in Alaska		
	Frequency	Total %
Less than 1 year	6	6.4%
1 year	10	10.6%
2-5 years	25	26.6%
6-10 years	22	23.4%
11 or more years	31	33.0%
Total	94	100.0%

Some teachers enter the profession after completing a career in another profession and are new to teaching at a more mature age. Table 25 describes the experience levels of the teachers in our sample and their age. While seven teachers over 40 years old had 1-5 years experience in teaching, none were in their first year of teaching.

Table 25:

Teacher age to total years taught

Age * Total Yrs Teaching						
		Total Yrs Teaching				
		Less than 1 year	1 - 5 years	6-10 years	11 or more years	Total
Age	20-29	5	8	0	0	13
	30-39	0	7	12	10	29
	40-49	0	3	2	10	15
	50-59	0	2	3	24	29
	60 or older	0	1	0	7	8
Total		5	21	17	51	94

The largest representation of teachers with the most years teaching at the school of the survey year were those with 5 or more years at the current school (36.2%), with the second largest group being those having been there 3-4 years (29.8%). Table 26 shows the experience of teachers at the current one to one school.

Table 26:

Teacher total years taught at current school

Yrs at Current School		
	Frequency	Total Percent
Less than 1 year	16	17.0%
1-2 years	16	17.0%
3-4 years	28	29.8%
5 or more	34	36.2%
Total	94	100.0%

Table 27 represents the experience of teachers in a one to one laptop program. Teachers having 3-4 years of experience in the one to one laptop program form the largest group (39.4%) in this survey, followed by those having 5 or more years (28.7%) being the second largest group. The smallest group of teachers had the least experience (14.9%).

Table 27:

Teacher one to one laptop teaching years

One to One Laptop Teaching Yrs		
	Frequency	Total %
Less than 1 year	14	14.9%
1-2 years	16	17.0%
3-4 years	37	39.4%
5 or more	27	28.7%
Total	94	100.0%

To better understand the teacher experience of laptop teaching within the current school, Table 28 indicates that 68 teachers (72.2%) had 3 or more years of experience in a one to one program and 81 of the 94 teachers (86%) had taught in a one to one program in the current school since the beginning of their time at the school.

Table 28:

Teacher years at current school to one to one laptop teaching years

Yrs at Current School * One to One Laptop Teaching Yrs						
Count						
		1:1 Laptop Teaching Yrs				
		Less than 1 year	1-2 years	3-4 years	5 or more years	Total
Yrs at Current School	Less than 1 year	12	1	2	1	16
	1-2 years	0	13	2	1	16
	3-4 years	1	2	19	6	28
	5 or more	1	0	14	19	34
Total		14	16	37	27	94

Teachers were asked their self-perception of technology adoption within the framework by Rogers, (2003) according to the work of Dalgarno, (2009). The largest group of teachers perceived their technology adoption to be “experienced” (46.8%) with the next largest group perceiving themselves as “intermediate” adopters (36.2%). Table 29 presents this self-perception of technology adoption of teachers.

Table 29:

Teacher perceived level of technology proficiency

Perceived Level of Proficiency		
	Frequency	Total %
Beginner	1	1.1%
Intermediate	34	36.2%
Experienced	44	46.8%
Expert	15	16.0%
Total	94	100.0%

The amount of professional development each respondent participated in toward the one to one laptop program, both district-provided and personally, was also determined. Table 30 presents responses of the participants regarding district sponsored professional development. Of the respondents, 82.6% said that their district had provided professional development activities that supported the one to one laptop program. Almost 14% of the respondents reported that they had no district sponsored professional development.

Table 30:

District sponsored professional development

. Has your school district provided you with hands-on professional development workshops, classes, activities that support the 1:1 laptop program in your district?			
		Frequency	Total %
Valid	Yes	76	82.6%
	No	13	14.1%
	N/A	3	3.3%
	Total N	92	100%

Table 31 represent the number of district sponsored professional development hours reported by the teachers. Thirty eight percent (38.0%) reported that the district provided 8 hours or less. This number includes the 17.4% that reported that the district did no training. 23.9% of teachers reported receiving 9 to 24 hours of professional development targeted at the one to one program, leading to the conclusion that 61.9% of teachers reported getting less than 25 hours instruction. 20.7% of teacher report that they have received 41 or more hours of district-sponsored professional development.

Table 31:

Number of district sponsored professional development hours

Number of professional development hours attended that were provided by your district for the 1:1 laptop program:			
		Frequency	Total %
Valid	8 hours or less	35	38.0%
	9 to 24 hours	22	23.9%
	25 to 40 hours	16	17.4%
	41 to 60 hours	8	8.7%
	61 to 80 hours	2	2.2%
	more than 80 hours	9	9.8%
	Total	92	100.00%

Teacher responses to the question of how many hours of professional development activities taken outside of school during personal time differed widely. The largest group reported their efforts in professional development opportunities during personal time participated in 27 hours or more (29.3%) with the second largest group reporting 0 hours (26.6%). 58.7% reported taking 9 or less hours of personal professional development during their own time. Table 32 presents the amount of time teacher spend on their own for professional development toward using technology in the classroom.

Table 32:

Number of hours spent in personal professional development

Number of hours in classes /seminars taken personally outside of school time		
Hours	Frequency	Total %
None	25	26.6%
3 hours or less	15	16.3%
4 to 9 hours	14	15.2%
10-18 hours	8	8.7%
19-27 hours	3	3.3%
More than 27 hours	27	29.3%
Total	92	100.00%

The bulk of the online survey were questions where the respondents rated their levels of use in various applications and situations with their personal, professional and classroom uses of technology. The established indices as outlined in Chapter 3 were used as the measures of proficiency. Total technology indices of TPU, TPP and TCU were used to measure the overall effects of the demographic variables. Significant differences between categories were found for district sponsored professional development and personal professional development taken outside of school. There was no significant difference in tests of ANOVA for demographic variables of age, total years teaching, total years teaching in Alaska, total years at current school, and total years teaching in a one to one laptop program to any index to indicate variability beyond randomness to say that the null hypothesis for question two is not rejected.

The main thrust of this research is to determine impact on classroom use of technology in the one to one program. While statistical analysis of personal use and professional practice is of interest and will be presented, further detailed analysis will be conducted on classroom use to better understand relationships of professional development and teacher tenure at the current school. Statistical analysis of differences of technology use by gender was not useful to this research. Differences of technology use by ethnicity did not contribute to any statistical analysis due to the small sets of respondents in multiple categories of ethnicity. Tables 33 – 35 report the ANOVA data for each set of demographics by each index.

Table 33:

Analysis of variance of means between demographics and TPU

Teacher Personal Use (TPU)			
Demographic Title	F	*df*	*p*
Age	1.105	4, 89	.359
Total years teaching	.913	3, 90	.438
Years taught in Alaska	1.657	4, 89	.167
Years taught in current school	.558	3, 90	.644
Years in a one to one laptop program	.231	3, 90	.875
Number of district provided professional development hours	3.018	5, 86	.015*
Number of hours spent personally in professional development activities	1.720	5, 86	.139
* equals significance			

Table 34:

Analysis of variance of means between demographics and TPP

Teacher Professional Practice (TPP)			
Demographic Title	F	*df*	*p*
Age	1.078	4, 89	.372
Total years teaching	.310	3, 90	.818
Years taught in Alaska	.340	4, 89	.850
Years taught in current school	1.056	3, 90	.372
Years in a one to one laptop program	1.469	3, 90	.228
Number of district provided professional development hours	6.037	5, 86	<.001*
Number of hours spent personally in professional development activities	3.770	5, 86	.004*
* denotes significance			

Table 35:

Analysis of varian of means between teacher demographic and TCU

Classroom Use of Technology (TCU)			
Demographic Title	F	*df*	*p*
Age	.974	4, 89	.426
Total years teaching	1.064	3, 90	.368
Years taught in Alaska	.565	4, 89	.689
Years taught in current school	.297	3,90	.828
Years in a one to one laptop program	1.469	3, 90	.228
Number of district provided professional development hours	2.329	5, 86	.049
Number of hours spent personally in professional development activities	2.728	5, 86	.025
* denotes significance			

The idea of technology being better implemented by younger teachers is one that is generally accepted but not found in the literature (Grunwald, 2010a). The lack of significance of age in the use of technology in the classroom in this research supports the literature.

A better understanding of the role of professional development in technology use related to teaching and classroom was necessary. A crosstabs analysis was conducted to help understand categories of the ordinal values of number of hours of personal professional development and number of hours of district professional development to the overall perceived perception of teacher proficiency established by the indices on total professional practice (TPP) index range and the total classroom use (TCU) in separate analyses. The results of that analysis are in Tables 36 and 37.

Table 36:

Hours in district-sponsored professional development by TPP LoA levels

TPP Total Index Range N - 92		Number of professional development hours attended that were provided by your district for the 1:1 laptop program:						
Level of Adoption (LoA)	% within TPP Index Range	8 hours or less	9 to 24 hours	25 to 40 hours	41 to 60 hours	61 to 80 hours	more than 80 hours	Total Teachers at each LoA level
Level 1 Proficiency	%	54.5 %	18.2%	9.1%	.0%	.0%	18.2%	
	Cases	6	2	1	0	0	2	11
Level 2 Proficiency	%	43.5 %	26.1%	26.1%	4.3%	.0%	.0%	
	Cases	20	12	12	2	0	0	46
Level 3 Proficiency	%	29.6 %	29.6%	7.4%	11.1%	3.7%	18.5%	
	Cases	8	8	2	3	1	5	27
Level 4 Proficiency	%	12.5 %	.0%	12.5%	37.5%	12.5%	25.0%	
	Cases	1	0	1	3	1	2	8

Table 37:

Time in classes/seminars outside of school time by TPP LoA levels

TPP Total Index Range N=92		Number of hours in classes/seminars taken personally outside of school time						
	% within TPP Index Range	None	3 hours or less	4 to 9 hours	10-18 hours	19-27 hours	More than 27 hours	Total Teachers at each LoA level
Level 1 Proficiency	%	54.5%	9.1%	18.2%	.0%	.0%	18.2%	
	Cases	6	1	2	0	0	2	11
Level 2 Proficiency	%	26.1%	23.9%	17.4%	13.0%	2.2%	17.4%	
	Cases	12	11	8	6	1	8	46
Level 3 Proficiency	%	22.2%	11.1%	14.8%	7.4%	3.7%	40.7%	
	Cases	6	3	4	2	1	11	27
Level 4 Proficiency	%	12.5%	.0%	.0%	.0%	12.5%	75.0%	
	Cases	1	0	0	0	1	6	8

This summary of categorical demographic information revealed that approximately 70% of teachers at Level 1 and 2 LoA of TPP had a total of less than 24 hours of district provided professional development since their one to one laptop program started, in contrast with 75% of all teachers at Level 4 who had over 40 hours of professional development. About sixty-four percent (63.6%) of Level 1 teachers put in 3 hours or less, with 54.5% reporting no professional development activities outside that which was district sponsored. About forty-five percent (45.4%) of Level 3 teachers and 87.5% of Level 4 teachers reported over 19 hours of professional development taken personally.

Summary data of the professional development questions to TCU LoA levels is presented in Tables 38 and 39 and indicate how TCU LoA and professional development frequencies of survey participants are distributed.

Table 38:
Time in professional development district-sponsored by TCU LoA levels

TCU Total Index Range N=92		Number of professional development hours attended that were provided by your district for the 1:1 laptop program:						
Level of Adoption (LoA)	% within TCU Index Range	8 hours or less	9 to 24 hours	25 to 40 hours	41 to 60 hours	61 to 80 hours	more than 80 hours	Total Teachers at each LoA level
Level 1 Proficiency	%	45.0%	20.0%	15.0%	5.0%	.0%	15.0%	21.7%
	Cases	9	4	3	1	0	3	20
Level 2 Proficiency	%	50.0%	28.6%	16.7%	2.4%	.0%	2.4%	45.7%
	Cases	21	12	7	1	0	1	42
Level 3 Proficiency	%	11.1%	22.2%	22.2%	22.2%	7.4%	14.8%	29.3%
	Cases	3	6	6	6	2	4	27
Level 4 Proficiency	%	66.7%	.0%	.0%	.0%	.0%	33.3%	3.3%
	Cases	2	0	0	0	0	1	3

Table 39:
Hours in classes/seminars outside of school time by TCU LoA levels

TCU Total Index Range N=92		Number of hours in classes/seminars taken personally outside of school time						
Level of Adoption (LoA)	% within TCU Index Range	None	3 hours or less	4 to 9 hours	10-18 hours	19-27 hours	More than 27 hours	Total Teachers at each LoA level
Level 1 Proficiency	%	45.0%	15.0%	10.0%	10.0%	.0%	20.0%	21.7%
	Cases	9	3	2	2	0	4	20
Level 2 Proficiency	%	31.0%	23.8%	16.7%	7.1%	2.4%	19.0%	45.7%
	Cases	13	10	7	3	1	8	42
Level 3 Proficiency	%	11.1%	3.7%	14.8%	11.1%	7.4%	51.9%	29.3%
	Cases	3	1	4	3	2	14	27
Level 4 Proficiency	%	.0%	33.3%	33.3%	.0%	.0%	33.3%	3.3%
	Cases	0	1	1	0	0	1	3

The summary of the data of TCU LoA to professional development hours had contrasting results. This analysis revealed that approximately 65% of teachers at Level 1 and 2 LoA of TCU had less than 24 hours of district provided professional development in contrast to 45.4% of all teachers at Level 3 and only one teacher in Level 4 had over 40 hours of professional development. Sixty percent of Level 1 teachers put in 3 hours or less, additionally 45% reporting no professional development activities outside that which was district-sponsored training. About sixty three percent of Level 3 teachers and 33.3% of Level 4 teachers reported over 19 hours of professional development taken personally.

In an effort to show how the variables relate to each other, Spearman's rank correlation coefficient (also knows as Spearman's rho denoted by ρ) was used to determine correlation. Relationships and the interpretation of effect size between variables in correlation tests are described by the scale in Table 40 according to (Cohen, 1988, p. 40).

Table 40:

Cohen's scale of effect size

Effect Size	
Large	≥ .5
Moderate	≥ .2 and ≤.5
Small	< .2

The number of hours of district sponsored professional development was found to have a small correlation to TCU, as shown by Spearman's rho (ρ (92) = .279, p<.01, two-tailed) and moderately correlated to TPP (ρ (92) = .318, p<.01, two-tailed). The numbers of hours in classes and seminars taken personally by teacher was found to be moderately correlated to TCU (ρ (92) = .359, p<.01, two-tailed) and TPP (ρ (92) = .340, p<.01, two-tailed.

To further investigate the significance of district provided professional development, a comparison of means between these professional development hours and the years taught in the current school was conducted. A moderate correlation (r (92) = .423 p<.001, two-tailed) of professional development provided by the district and years taught in the current school was found as one would expect as teachers remained in the one to one laptop programs and participated in the district provided professional development.

To see the effects of the two variables on the use of technology used in the classroom as measured by TCU, a univariate general linear model excluding the intercept was conducted between the variables. The equation for this calculation is:

$$TCU = b_1 * YrsCurSchool + b_2 * NumHrsDSPD \qquad \text{(equation 1)}$$

Where a) TCU = Total Classroom Use, b) YrsCurSchool = Teacher years at current school, and c) NumHrsDSPD = Number of hours of district sponsored professional development.

From this analysis, ($F_{6,86}$= 82.897, p<.001, R^2=.853), 85% of the variability in TCU can be attributed to the variability of both years in the current school and the number of professional development hours sponsored by the district. This regression analysis is a good fit because of the high R value.

In order to better understand the significance of the relationship between the one to one experience at that school and the amount of professional development obtained, Table 41 was constructed to better see the distribution of teachers in the categories of each variable.

Table 41:

Current school teaching yrs to district provided professional development

Current School Teaching Yrs * Number of professional development hours attended that were provided by your district for the 1:1 laptop program							
	8 hours of less	9 to 24 hours	25 to 40 hours	41 to 60 hours	61 to 80 hours	More than 80 hours	Total N
Less than 1 year	8	6	1	1	0	0	16
1 – 2 years	9	4	2	1	0	0	16
3 -4 years	12	7	4	4	0	1	28
5 or more years	6	5	9	2	2	8	32
Total	35	22	16	8	2	9	92

The amount of professional development teacher participate in increases over years as it is offered through school districts. The majority (57%) of teachers with less than 2 years of experience had less than 8 hours of opportunity. If the district offered one full workday per year, teachers with 3-4 years of experience would have 24 – 32 hours of exposure. Approximately sixty-eight percent (67.9%) of that group had less than 25 hours of opportunity with 14 having less than 8 hours. If those teachers with 5 years or more had the same opportunity, they would have at least 40 hours of opportunity. Eleven of 26 (37%) teachers in this category had 41 hours or more with 8 having more than 80 hours. This possibly indicates that more professional development was offered toward the one to one program early on with more recent teachers to the program receiving less opportunity per year than was offered earlier in the program.

4.1.2 Research question two.

"Do teachers' perceived levels of uses in their personal life and professional practice affect the types of technology uses in the classroom?" The indices of total personal use (TPU), total professional practice (TPP), and total classroom use (TCU) were developed from multiple responses to questions relating to teachers technology frequencies of uses and levels of proficiency in those areas. From these responses, the respective index was developed and each individual was placed within one of four categories of levels of adoption (LoA) derived from an index percentage. The four LoA levels (Level 1 representing most novice to Level 4 as most advanced) were developed in this research and adapted from the work of Lemke, (2009). The frequency of distribution of the sample population of teachers is reflected in Figures 8, 9, and 10.

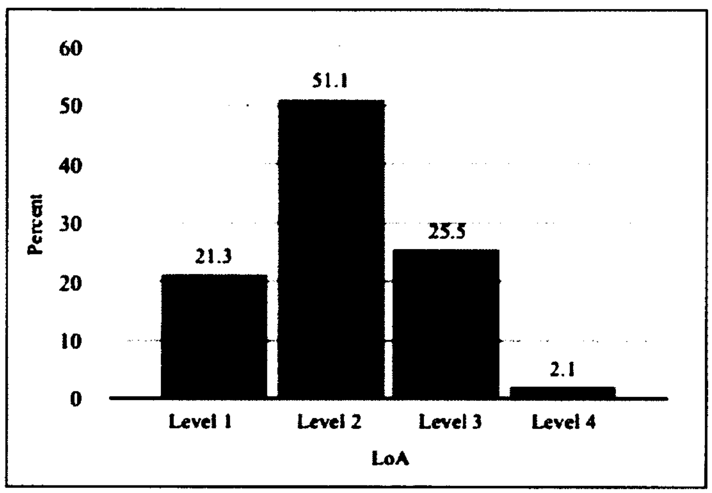

Figure 8. Frequency and percents in LoA in personal use (TPU)

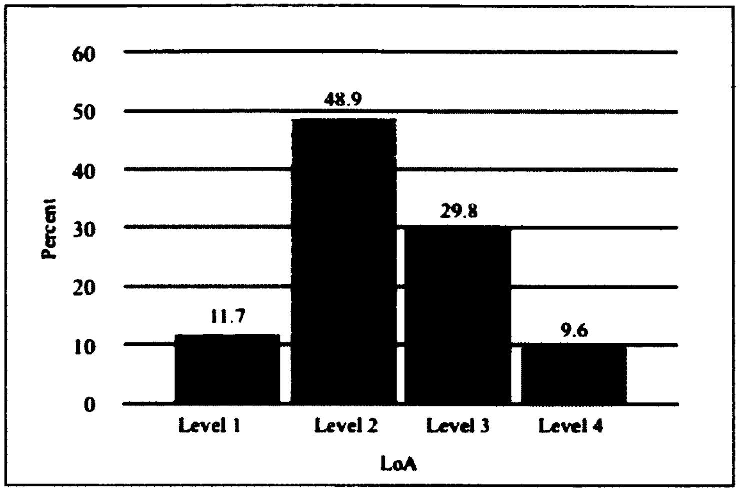

Figure 9. Frequency and percents in LoA in professional practice (TPP)

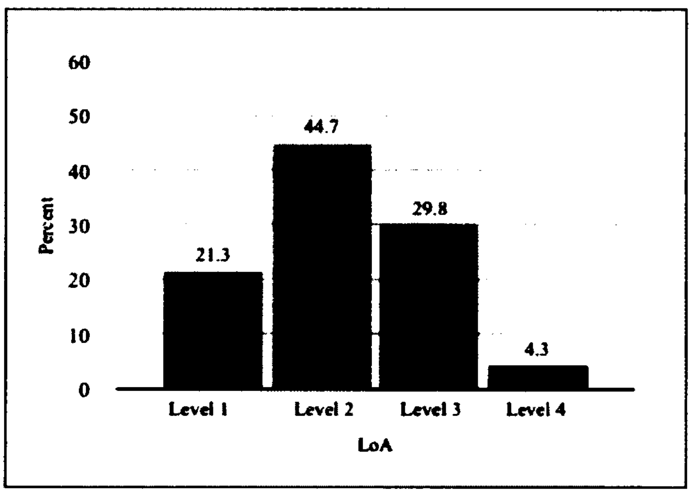

Figure 10: Frequencies and percents of LoA in classroom use (TCU)

An analysis of variance (ANOVA) was conducted to determine any variations of means between the LoA categories within the three indexes. Reporting was done in the format for ANOVA, correlation and regression suggested by Stieve, (2011). Significant difference was found between means of TPU to TPP ($F_{3,90}$= 21.071, p<.001), TPU to TCU ($F_{3,90}$= 9.522, p<.001), and TPP to TCU ($F_{3,90}$= 18.757, p<.001). Thus, the null hypothesis presented in Question 2 is rejected.

Additional analysis was in order to first determine if the LoA categories provided parallel results to the continuous data, how LoA ranges, were related and whether the LoA index ranges of TPU and TPP predict TCU. To find the relationship between the two ordinal variables TPU and TPP LoA range to TCU LoA, correlations using Spearman's ρ for analysis of ordinal variables were run. A large effect size with a strong correlation was found to exist between TPU to TPP (ρ (94) = .622, p<.01), two-tailed and a moderate correlation was found between TPU and TCU LoA ranges (ρ (94) = .450, p<.01, two-tailed. A large effect size showed strong correlation between TPP and TCU LoA ranges (ρ (94) = .618, p<.01, two-tailed).

Correlations between the two continuous indices of TPU and TPP and another between three continuous values of indices TPU, TPP, and TCU were calculated. Using Pearson's correlation for continuous variables between TPU Index and TPP Index, large correlations were found (r (94) = .761 p<.001, one-tailed). A large effect size provided a strong positive correlations of TPU (r (94) = .501 p<.001, one-tailed) and TPP (r (94) = .729 p<.001, one-tailed) were found to TCU.

To determine the predictive values of each index of personal use and professional practice to classroom use, a regression analysis was performed on both indice percentage of TPU and TPP to TCU. Both variables were significant predictors by themselves. Intercepts were not included in the calculations. TPU largely predicted TCU, $F_{1,93}$=349.745, p<.001, R^2=.788. TPP was a slightly stronger significant predictor of TCU, $F_{1,93}$=528.554, p<.001, R^2=.849. Figure 11 shows the scatterplot of the individual responses of both the TPU and TPP to TCU.

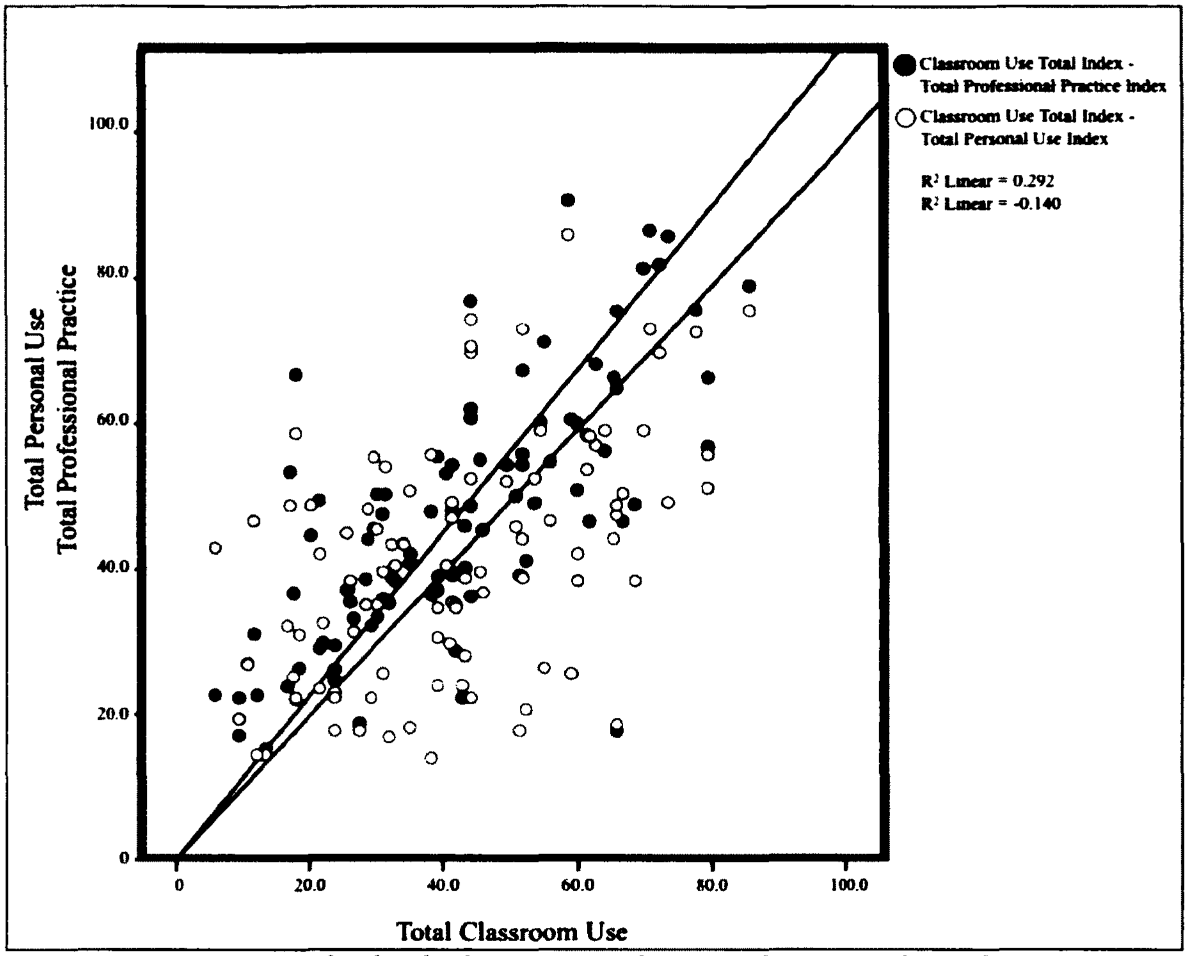

Figure 11. Regression of individual responses of TPU and TPP to TCU index.

The equation for a test of multiple regression is:

$$TCU = b_1 * TPU + b_2 * TPP \qquad \text{(equation 2)}$$

Where TCU = Total Classroom Use index; TPU = Total Personal Use index; and TPP = Total Professional Practice Index.

In this analysis, TPU and TPP together were shown to be significantly predictive of TCU, $F_{2,92}$=262.131, p<.001, R^2=.851. The independent variable for TPU had B= -.100, β= -.074, p=*.648.* The independent variable for TPP has a standardized B=1.180,

β=.994, and p<.001. When the two indices TPU and TPP were slightly better than either one alone, the difference between using both indices together and that of using TPP alone was a difference of R^2 of .002. This effort taken to calculate TPU to gain an additive difference to predictive value of TPP may be more difficult than is warranted, given the predictive value of TPP alone.

4.1.3 Research question three.

"What is the level of adoption of the one to one laptop program as measured by the framework of the adoption of innovation, the Concerns Based Adoption Model (Hall & Hord, 2011)?"

The purpose of this question, in part, was to gain understanding of teachers concerns and perceptions of the implementation of their one to one laptop program. The Concerns Based Adoption Model (CBAM) was one method included in the study. The CBAM is a model to determine the level of adoption of an innovation, in this case, the laptop program. The Stages of Concern (SoC) is a measure of the teacher concerns regarding this adoption level. The range of stages of concern were measured using the questions 9.4.7, 9.4.3, 9.4.4, 9.6.3, 9.4.6, 9.6.4, and 9.6.7, representing the seven categories of concerns and adapted from Dalgarno, (2009). The four point scale used for these questions by Dalgarno, (2009) was modified to a five point Likert scale of "Not at all like me," "A little like me," "Somewhat like me," "A lot like me," and "Exactly like me," to provide consistency of answers in the overall survey of this research study. Overall frequencies are presented in Table 42 for each question of the SoC.

Table 42:

Frequencies of individual SoC questions

		Not at all like me		A little like me		Some what like me		A lot like me		Exactly like me	
Stage of Concern	Question	N	%	N	%	N	%	N	%	N	%
0	I am not concerned about the laptop program.	46	48.9	15	16	16	17	13	13.8	4	4.3
1	I have a very limited knowledge about the laptop program.	52	55.3	27	28.7	11	11.7	4	4.3	0	0
2	I would like to know how my role will change when I am using the laptops for teaching.	22	23.4	25	26.6	21	22.3	20	21.3	6	6.4
3	I am concerned about my time spent working with nonacademic problems related to the laptop program.	21	22.3	26	27.7	20	21.3	20	21.3	7	7.4
4	I am concerned about how the laptop program affects students.	21	22.3	23	24.5	19	20.2	19	20.2	12	12.8
5	I would like to coordinate my efforts with others to maximize the effects of the laptop program.	10	10.6	16	17	30	31.9	27	28.7	11	11.7
6	I would like to determine how to supplement or enhance the laptop program.	6	6.4	24	25.5	23	24.5	24	25.5	17	18.1

In order to better understand the maturity of the innovation, a SoC profile for the sample can be calculated from the means of sample SoC questions (Hall & Hord, 2011). Table 43 presents those means.

Table 43:

Means of sample SoC questions

Stage of concern	Survey statement	Survey Item #	N	Missing	Mean	Std. Deviation
Stage 0: Awareness	I am not concerned about the laptop program.	9.4.7	94	0	2.0851	1.26712
Stage 1: Informational	I have a very limited knowledge about the laptop program	9.4.3	94	0	2.0851	0.85141
Stage 2: Personal	I am concerned about conflict between my interests and my responsibilities in the laptop program.	9.4.4	94	0	2.6064	1.23757
Stage 3: Management	I am concerned about the time I spend working with nonacademic problems related to the laptop program.	9.6.3	94	0	2.6383	1.25167
Stage 4: Consequences	I am concerned about how the laptop program affects students	9.4.6	94	0	2.7660	1.34744
Stage 5: Collaboration	I would like to coordinate my efforts with others to maximize the effects of the laptop program.	9.6.4	94	0	3.1383	1.16028
Stage 6: Refocusing	I would like to determine how to supplement, enhance, or replace the laptop program.	9.6.7	94	0	3.2340	1.20416

Figure 12 demonstrates the SoC profile for the sample developed through the means of the survey questions above.

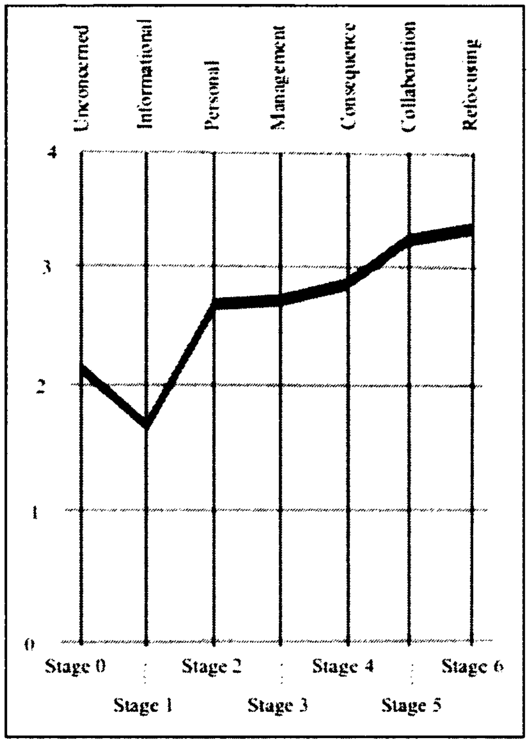

Figure 12. SoC survey questions profile

An interpretation for the SoC profile can be accomplished by examining the high stage score and the second highest stage score (First and Second High Stage Score Interpretation in (Hall et al., 1977). The profile indicates that Stage 5 Collaboration and Stage 6 Refinement had the most respondents in this sample. Although there are some differences, an example most closely representing the study's profile would be that of a High Impact Concerned User (Hall et al., 1977, p. 67). High Stage 4 Consequence and Stage 5 Collaboration represent an ideal profile for a concerns-based implementation effort (Hall & Hord, 2011). This type of user reflects a broad range impact user who is familiar with the innovation and wishes to work together with other to refine and maximize the innovation for the student. Stage 2 Personal and Stage 3 Mechanical are not major concerns of this user.

Two additional examples, one of a profile of High Impact Concerned User, and one from an ideal professional learning community, are shown in Figure 13 and Figure 14.

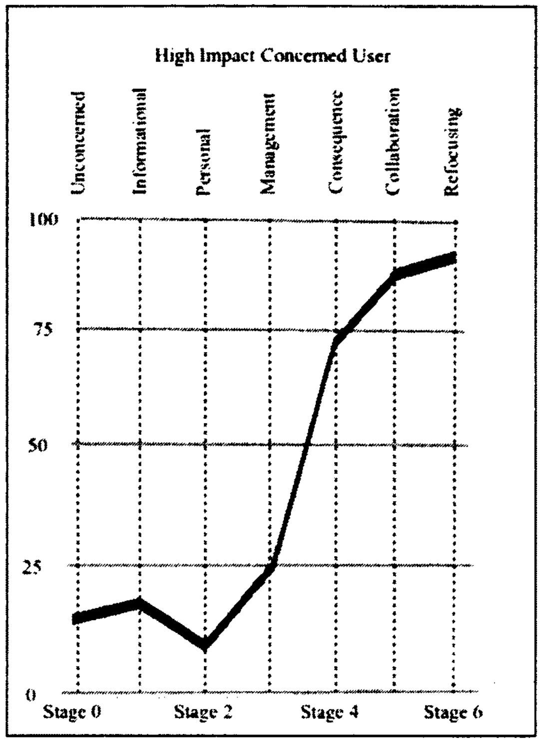

Figure 13. High Impact Concerned User

Figure 14. SoC ideal concerns-based implementation

As the one to one programs in the schools in this sample are more mature having been initially implemented between 3 to 5 years ago, there is an expectation that Stage 0 Awareness and Stage 1 Informational would be the lowest concerns for teachers. In Figure 13, Stage 2 Personal and Stage 3 Mechanical seem to be higher than what is to be expected in an ideal implementation and in implementations considered mature. Stage 2 Personal has to do with the effects of the one to one program on the teacher personally in terms of competition of the program toward other personal interests and the need to alter behavior for the program. Stage 3 Mechanical are concerns that may be related to technical and logistical issues that are not related to instructional issues. These concerns could be about the levels of support and direction of visions and goals of a program that would better suit the student in a High Impact Concerns user.

A level of use (LoU) framework was included in the study to help identify teachers' perception of the inclusion of the laptops in their teaching practice. The LoU has eight stages of which to determine how people respond to an innovation. The first three levels are considered non-users, and the remaining levels designate a hierarchy of use (Hall & Hord, 2001). While the SoC indicate concerns that teachers have, the LoU represents what teachers report they do.

A single question to measure the self-perceived Level of Use (LoU) for teachers was administered (Q9.2) as identified by (Trinidad et al., 2006). This was to allow teachers to indicate the overall LoU as prescribed by CBAM. This profile is indicated in Figure 15.

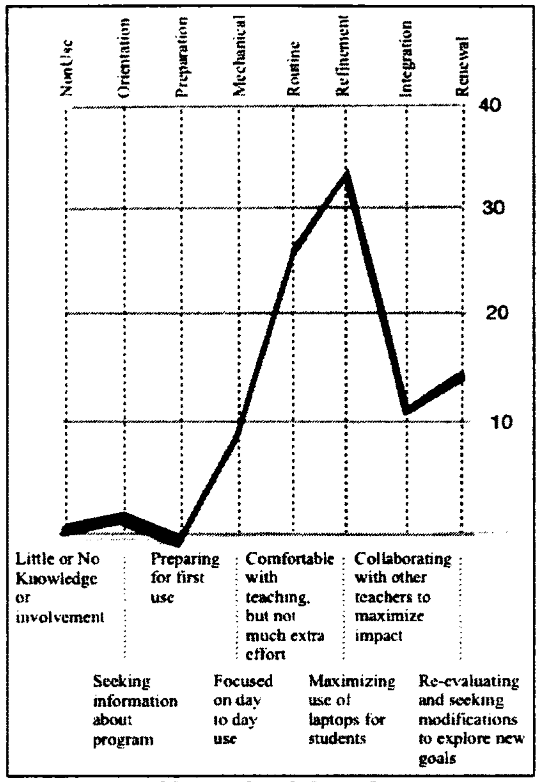

Figure 15. Teacher CBAM LoU profile and ACOT alignment

This profile stresses actions taken by teachers in their practice of using the laptops in the classroom. The laptop programs in the surveyed schools had been in place at least three years and some almost six years. Few teachers identified themselves as non-users or just getting ready to start as the laptop programs were in place and the survey was taken at the end of the school year. The most common LoU indicated by the teachers was categorized as "refinement" showing concern about maximizing the use of the laptops with students. This concern for maximizing the use of the laptops for students is one that is strived for in a concerns-based implementation (Hall & Hord, 2011).

The second most prevalent concern indicated by the teachers were "routine" indicating that teachers were comfortable with the laptops but indicated not much effort or concern about improving consequences. Routine (IVb) in an implementation that is mature but sill having opportunity for improvement could be an indication of accommodation to circumstances and could lead to a focus of problems or barriers.

Additional information provided by open-ended questions may give more information in these regards.

The CBAM profile also parallels the levels of adoption in the ACOT model of Evolution of Thought and Practice (Trinidad et al., 2006). Using the ETP, teachers would be seen as moving out of Adaptation into Appropriation. With the maturity of this laptop program, more of a move into Invention might be expected.

While the mean for the desire for Stage 5 Collaboration was high in the SoC, the actual reporting of collaboration with other teachers was lower in the LoU. This may be an artifact of time allocated for collaboration between staff. A significant number of one to one laptop schools in the survey population fell in small communities of rural and bush Alaska that are isolated by limited transportation systems and geography and where teachers can also feel isolated in a professional sense.

Caution must be taken with any interpretation of CBAM profiles in accepting them as truth (Hall et al., 1977). Interpretations are only good as the measure, the genuineness of the respondent, and the skill of the interpreter. Because of this self-reporting by teachers, this statement not only includes CBAM measures but also those of any measure of technology. Multiple measures of technology adoption have been used in this study to ascertain teacher adoption in varying manners. However, readers are cautioned to accept any interpretation of CBAM or this study as a hypothesis, which can only be confirmed by the respondents.

4.1.4 Research question four.

"How do teachers use of technology differ in personal use and classroom use as compared to students?" In an attempt to understand how teachers and students used the technology in a one to one laptop programs, frequencies of the types and uses of different applications and strategies were studied.

Students and teachers were asked similar questions regarding their personal use of technology. While a formal analysis between the teacher and student data is not appropriate in that the data comes from two separate surveys and had different sample sizes coming from different school districts, the responses to similar questions still provide useful information. Some differences in percentage of respondents in various categories of applications were found. 99% of teachers (N=94) reported using email fairly often or very often compared to 58.8% of students (N = 705). 22.6% of students reported that they never used email.

Teachers reported other use of some applications more than students; (a) teacher blogs almost double the rate of student blogs, 19% to 10% fairly often or very often respectively; (b) RSS feeds almost triple the rate at 24.4% to 7.8% occasionally or more often; and (c) Internet browser, 92.7% to 72.2% respectively fairly often to very often. The use of social networking by teachers was reported to be much less than students at 32.9% to 71.2% fairly often or very often. Figures 16 and 17 show frequencies by percentage of responses for teachers. The frequencies by percentage of responses for students are shown in Figure 18 and 19.

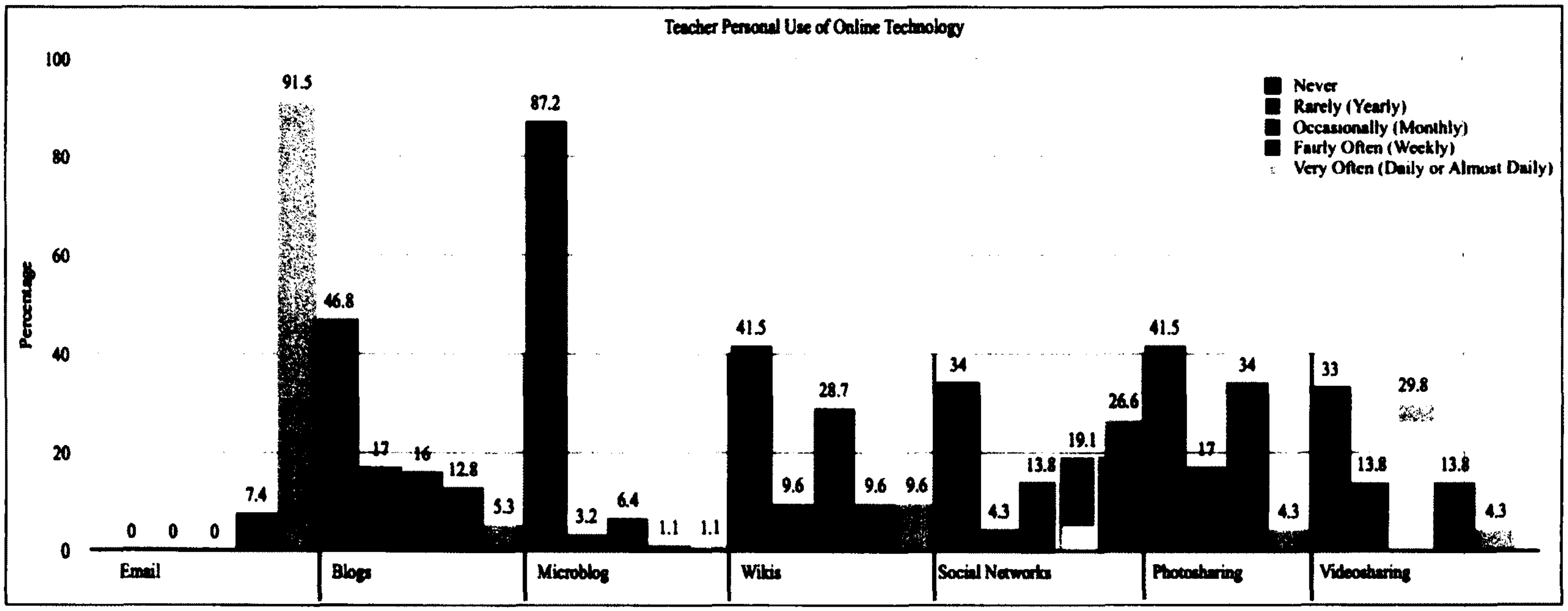

Figure 16: Teacher personal use of online technology

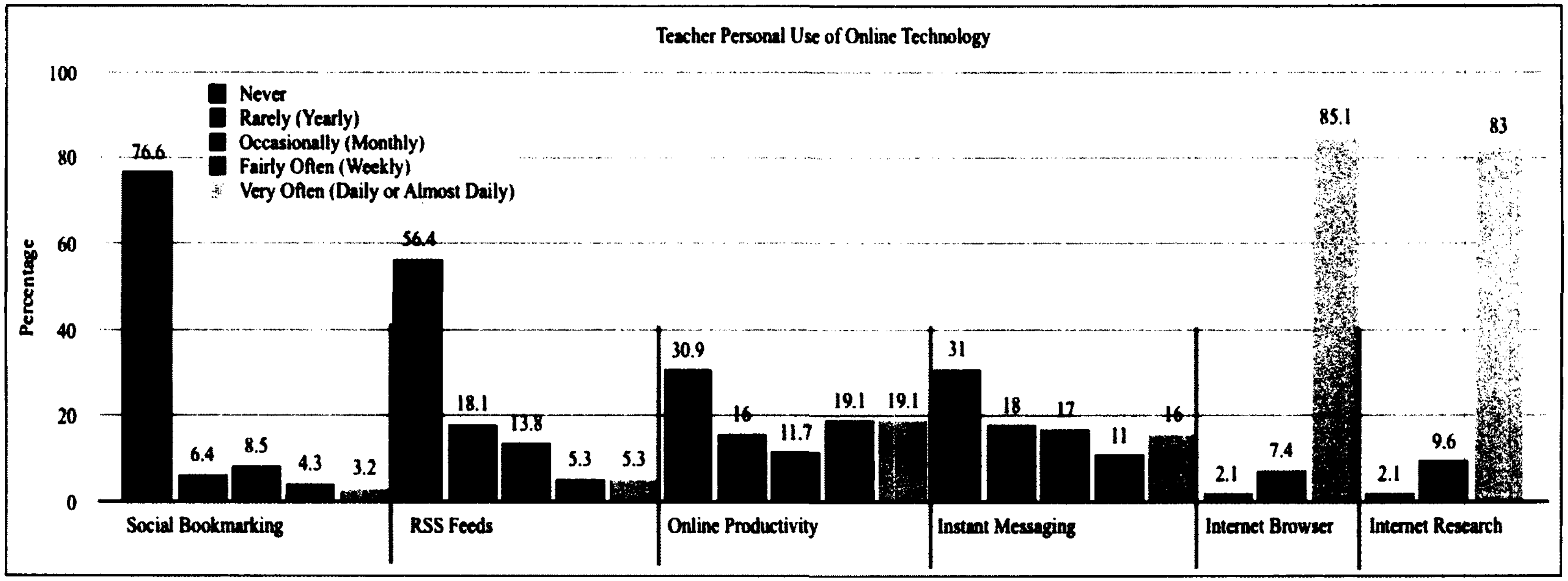

Figure 17: Teacher personal use of online technology

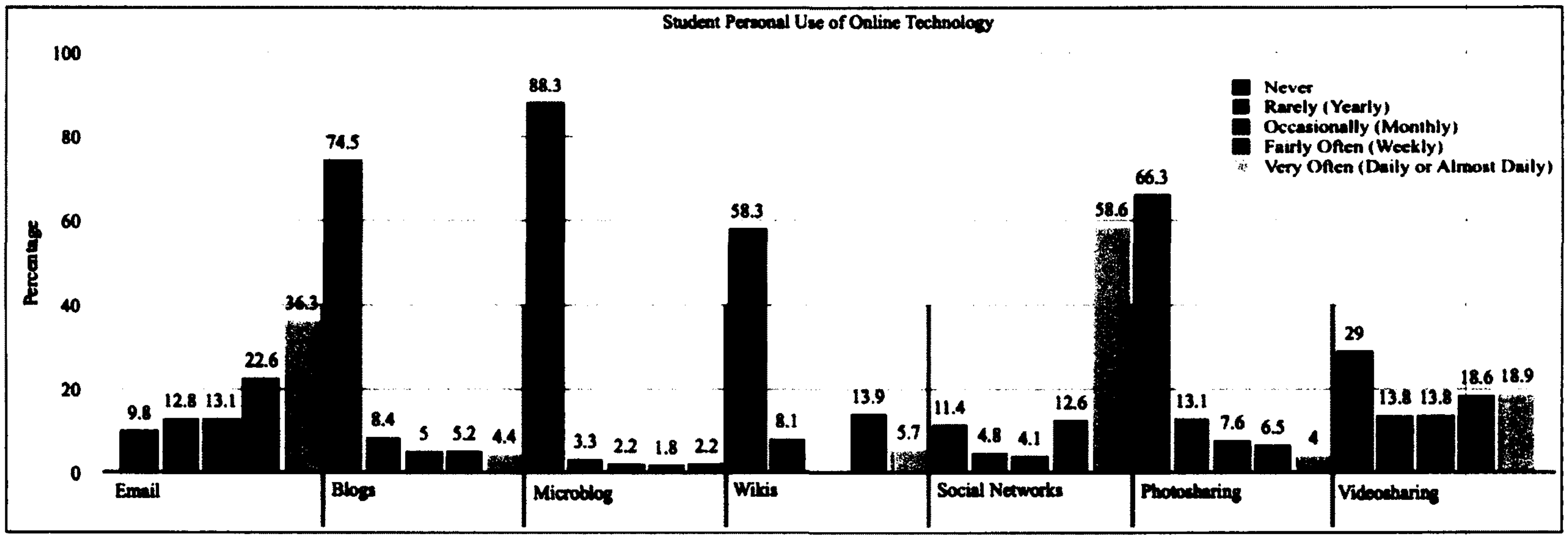

Figure 18: Student personal use of online technology

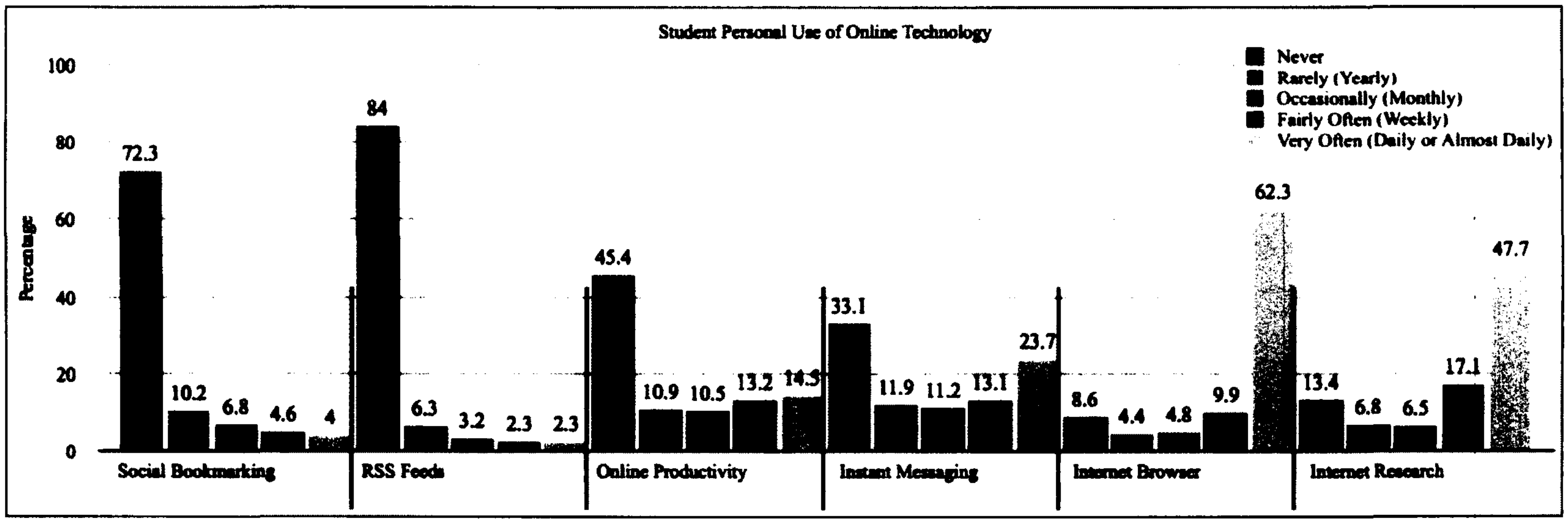

Figure 19: Student personal use of online technology

Roles played by teachers when using technology in the classroom were identified as outlined by (Lemke, 2009). The scoring guide provided with the survey established the questions to be included within each role in each category of TPU, TPP, and TCU. Table 44 - 46 presents the mean and standard deviation of each individual question as calculated from Table 15.

Table 44:

TPU roles: Mean, standard deviation and frequency percentages of LoA

TPU			Teacher frequency percentage in LoA levels				
	Mean	Std. Dev.	LoA Level 1%	LoA Level 2 %	LoA Level 3 %	LoA Level 4 %	N
Change Agent	2.31	.892	19.1	40.4	30.9	9.6	94
Communicator/Connector	2.49	.925	16.0	33.0	37.2	13.8	94
Contributor	1.78	.798	41.5	39.4	17.0	2.1	94
Producer	2.19	.942	29.8	27.7	36.2	6.4	94
Consumer	2.35	.799	9.6	56.4	23.4	10.6	94

Table 45:

TPP roles: Mean, standard deviation and frequency percentages of LoA

TPP			Teacher frequency percentage in LoA levels				
	Mean	Std.Dev.	LoA Level 1%	LoA Level 2 %	LoA Level 3 %	LoA Level 4 %	N
Change Agent	2.32	.870	17.0	43.6	29.8	9.6	94 94
Communicator/Connector	2.14	.811	22.3	45.7	27.7	4.3	94
Contributor	1.67	.835	53.2	29.8	13.8	3.2	94
Producer	2.53	.842	11.7	34.0	42.6	10.6	93
Consumer	2.61	.765	4.3	43.6	39.4	12.8	94
Implementer	2.93	.845	4.3	26.6	41.5	27.7	94

Table 46: *TCU roles: Mean, standard deviation and frequency percentage of LoA*							
TCU			Teacher frequency percentage in LoA levels				
	Mean	Std. Dev.	LoA Level 1%	LoA Level 2 %	LoA Level 3 %	LoA Level 4 %	N
Change Agent	2.07	.930	35.1	26.6	34.0	4.3	94
Communicator/Connector	2.01	.933	35.1	36.2	21.3	7.4	94
Contributor	1.66	.911	59.6	19.1	17.0	4.3	94
Producer	2.17	.900	25.5	49.4	27.7	7.4	94
Consumer	2.70	.902	10.6	35.1	40.4	13.8	94
Implementer	2.57	.861	11.7	24.5	45.7	18.1	94

In order to graphically compare the three indices in regards to LoA levels, Figures 20-24 are presented. Due to the lack of internal consistency of questions to determine TPU and TCU Consumer (Chronbach alpha < .70), indices for those categories were not calculated.

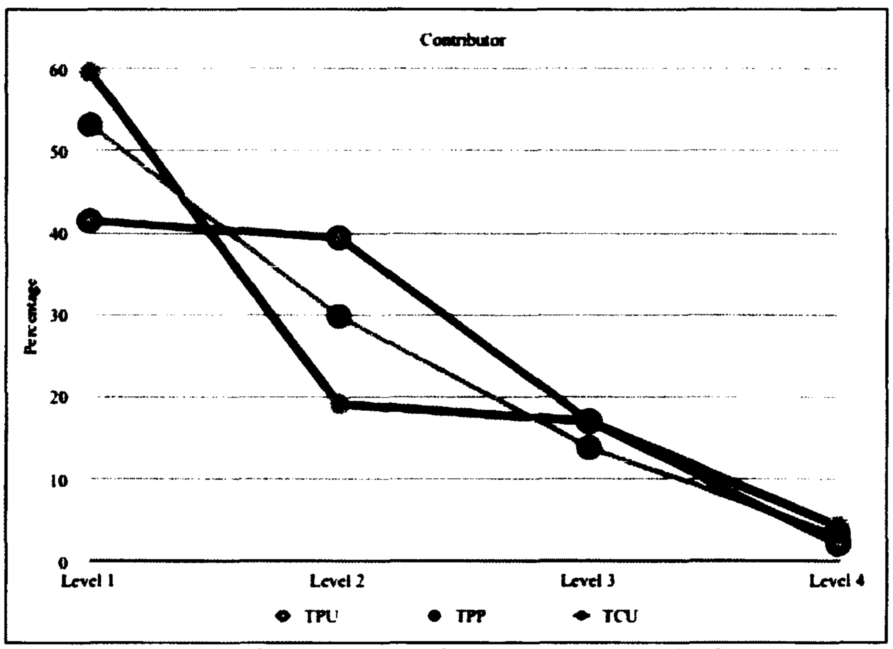

Figure 20. Change agent role levels of LoA for TPU, TPP, and TCU.

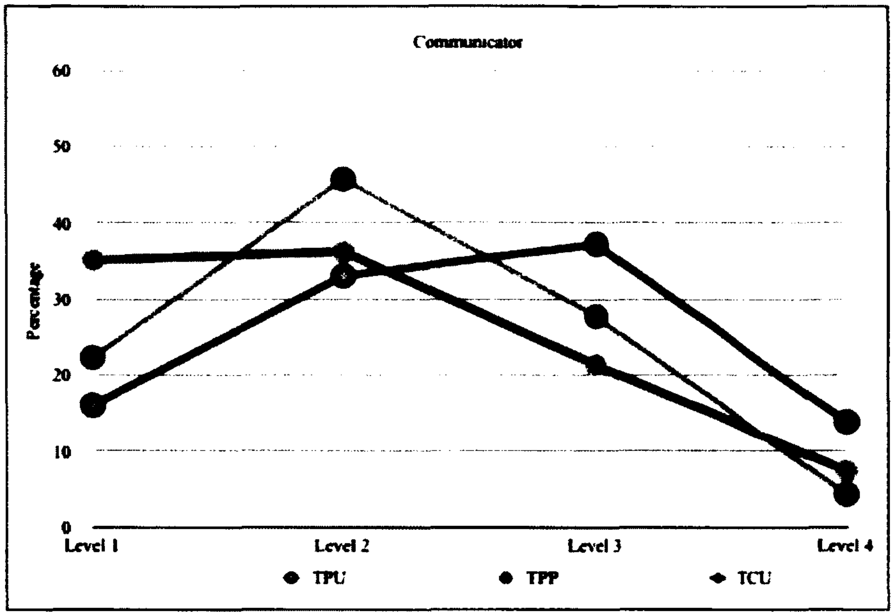

Figure 21. Communicator role levels of LoA for TPU, TPP, and TCU

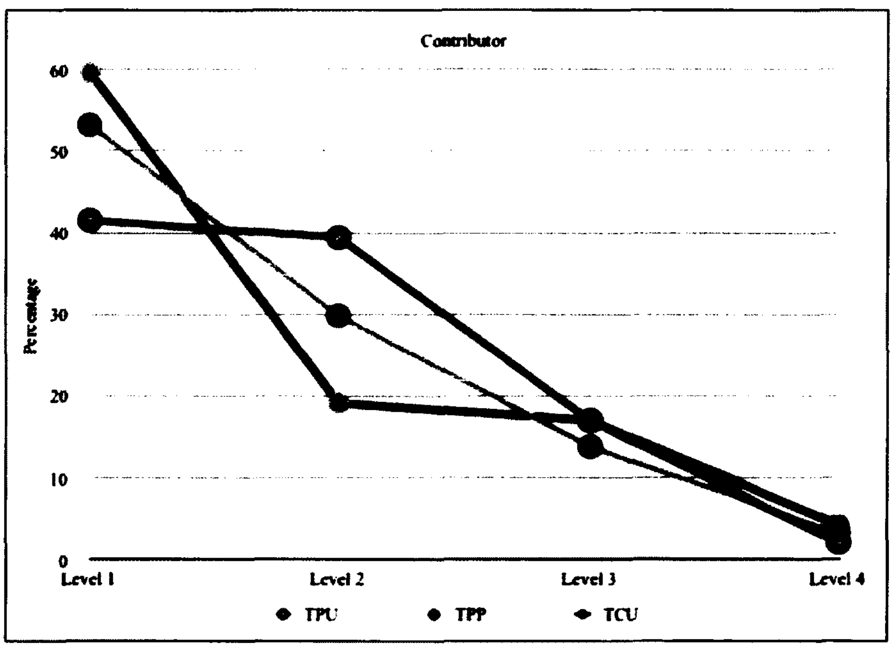

Figure 22: Contributor role levels of LoA for TPU, TPP, and TCU

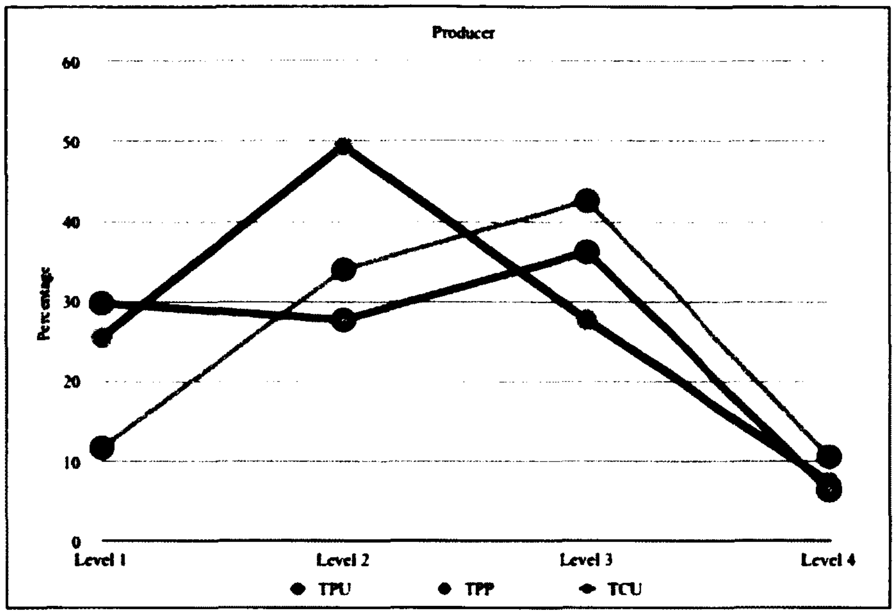

Figure 23. Producer role levels of LoA for TPU, TPP and TCU.

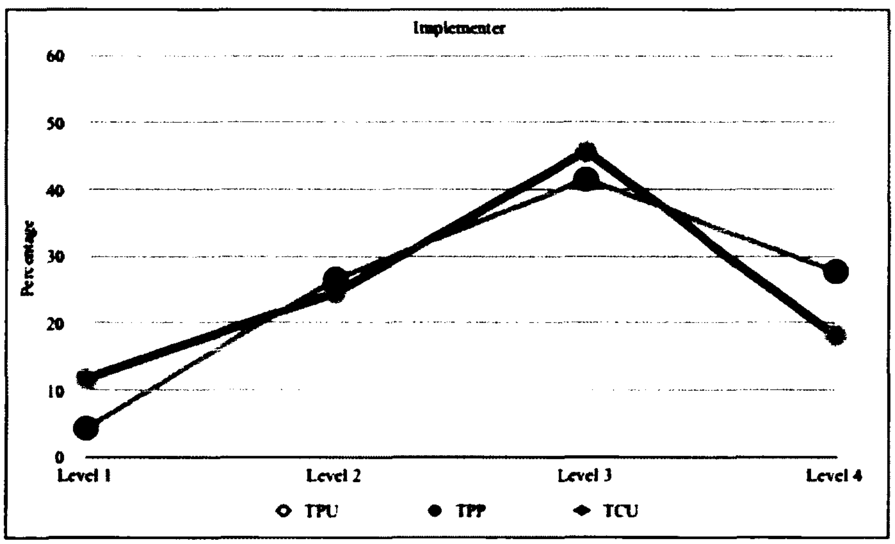

Figure 24. Implementer role levels of LoA for TPU, TPP, and TCU.

The individual questions asked of teachers used in the development of TCU reveal additional information regarding their use of technology in the classroom and the roles they play. Figures 25 to 30 present the responses to the indicated questions for each individual roles teachers play in the classroom according to the Lemke framework (Lemke, 2009). Teachers and students had the option to select an additional response for the specific applications for classroom use that stated they would use the application more if it was not blocked at school. This response choice created non-random missing data, with the actual N reported with each representation of data.

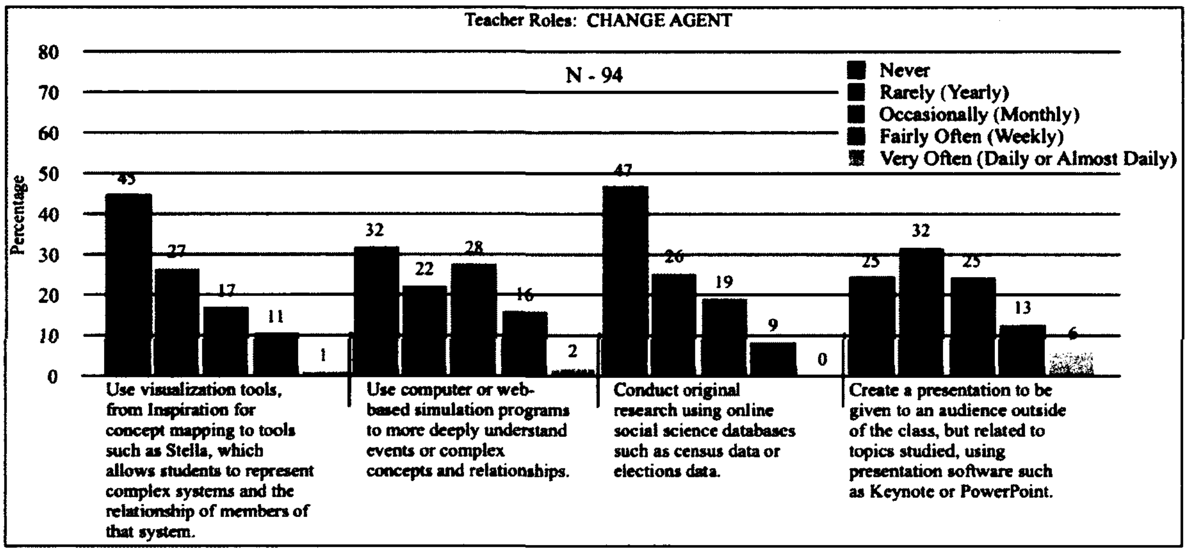

Figure 25. Teacher classroom roles: change agent

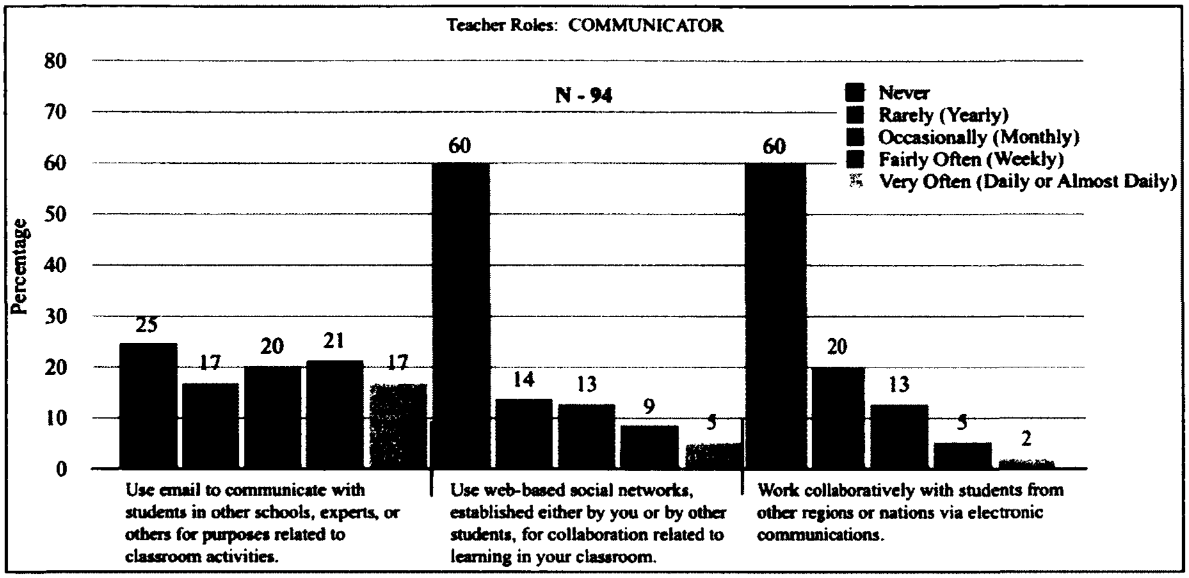

Figure 26. Teacher classroom roles: communicator

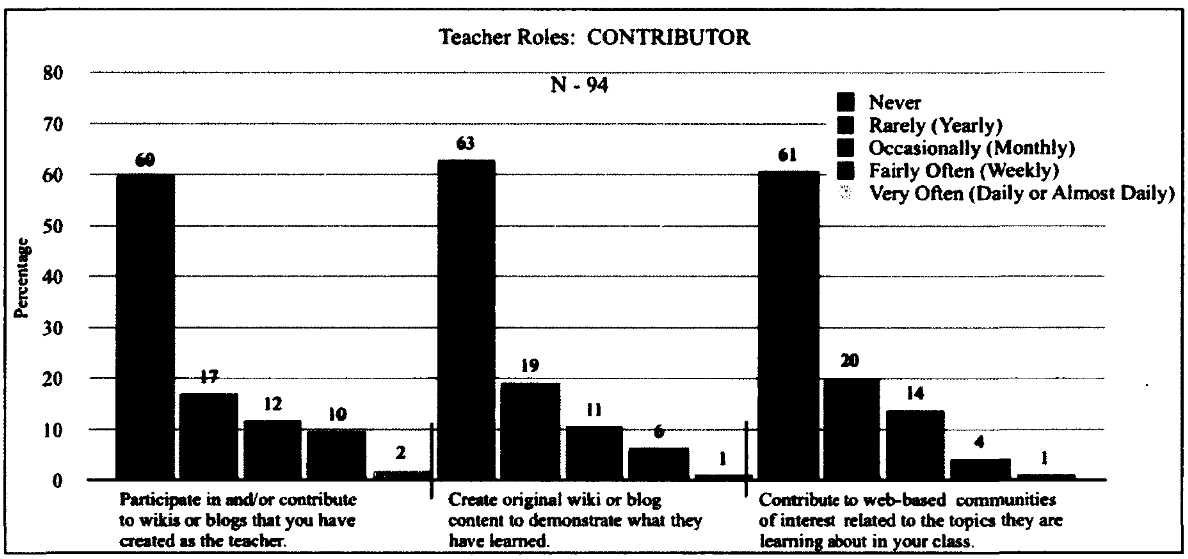

Figure 27. Teacher classroom roles: contributor

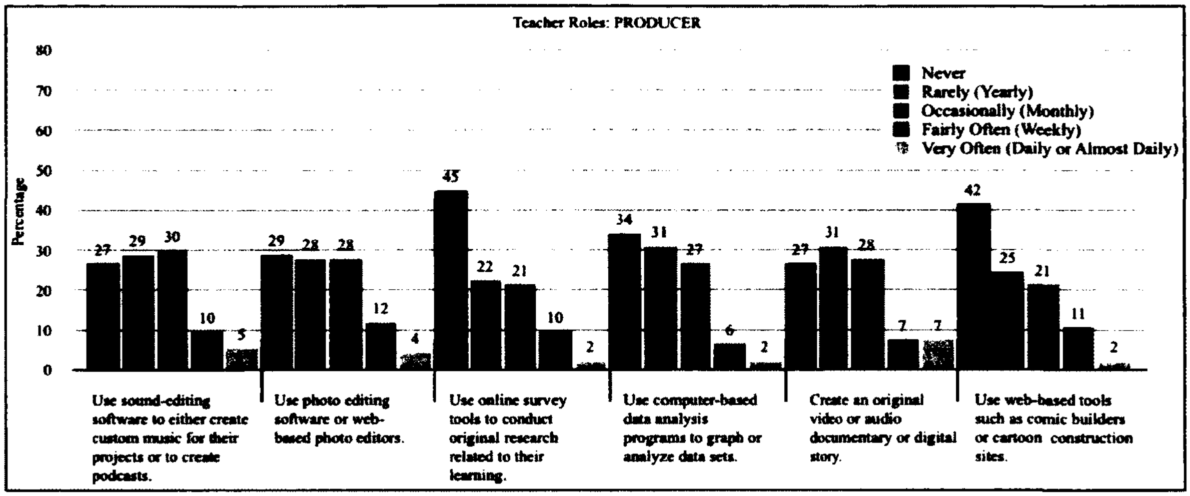

Figure 28. Teacher classroom roles: producer

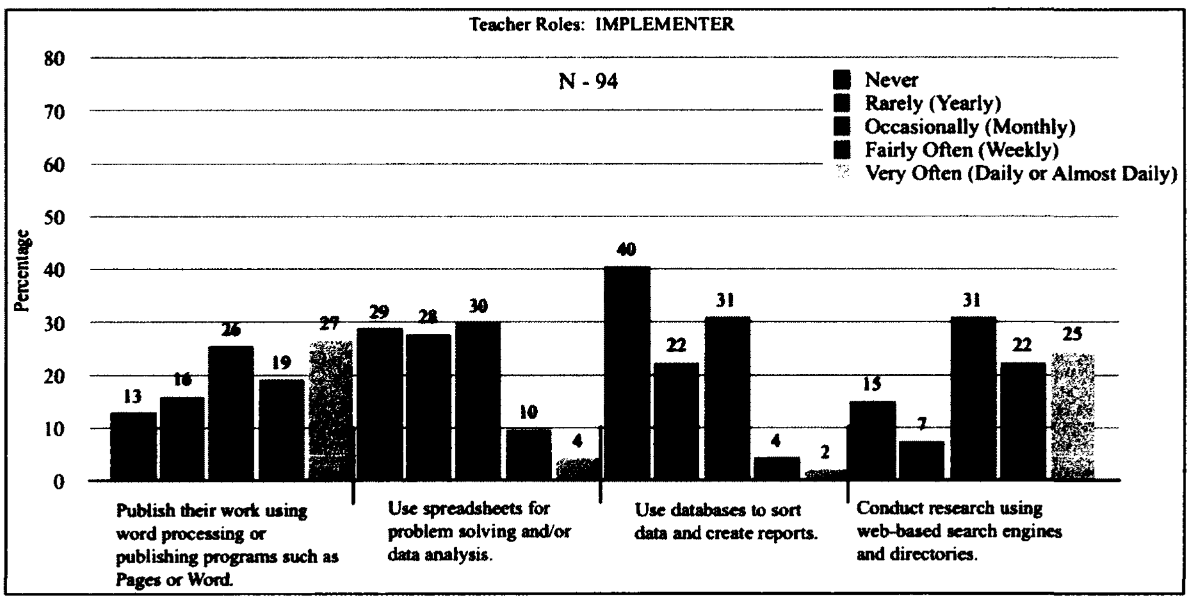

Figure 29. Teacher classroom roles: implementer

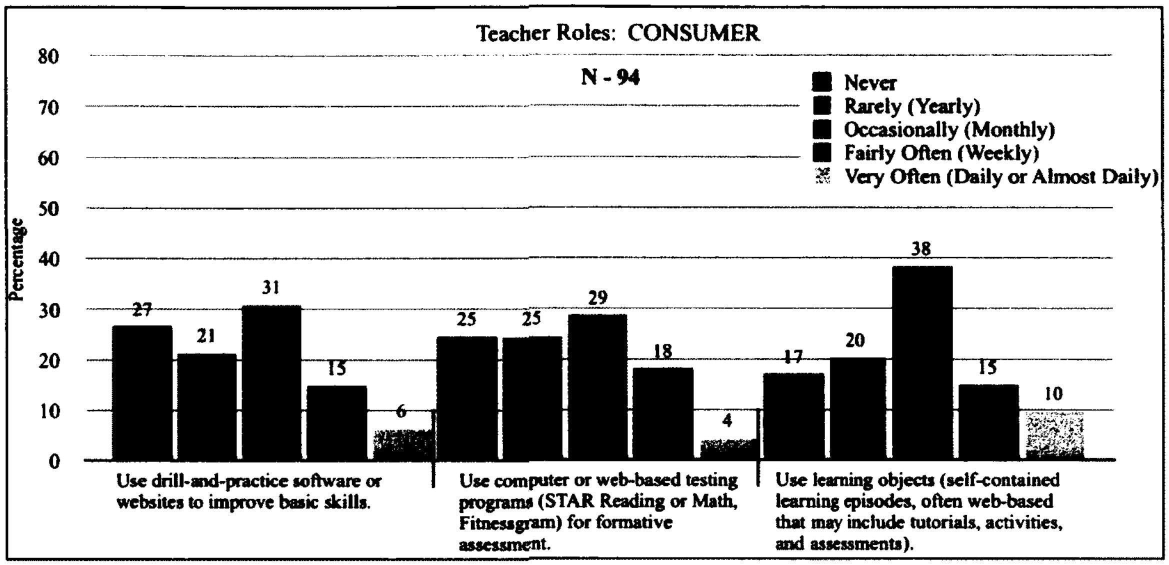

Figure 30. Teacher classroom roles: consumer

Students responded to several questions aligned to the teacher survey and according to teacher roles. The results from these questions are presented in Figures 31-34.

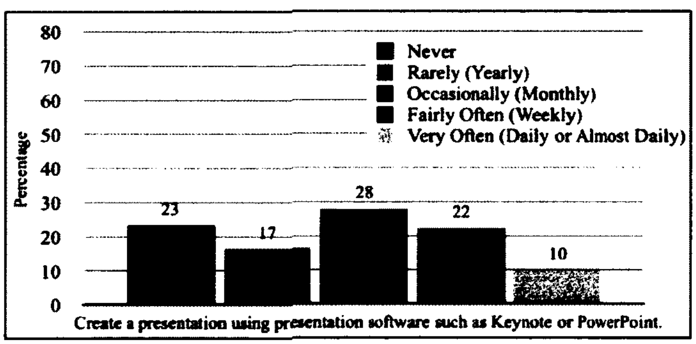

Figure 31. Student use of presentation applications (N=678)

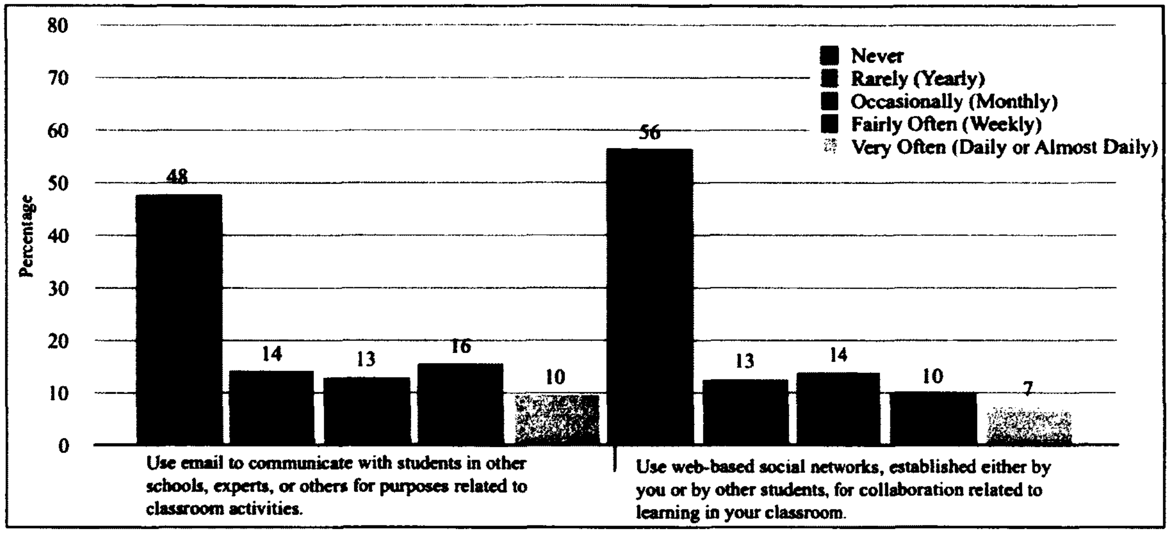

Figure 32. Student use of communication tools in the classroom (N=-687, 705)

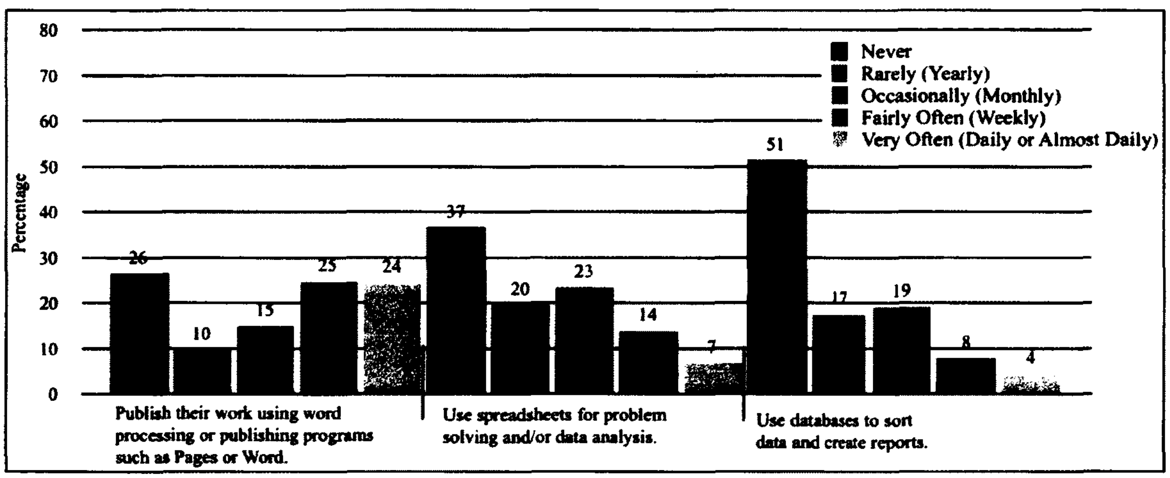

Figure 33. Student implementation of technology in the classroom (N-696, 707, 705)

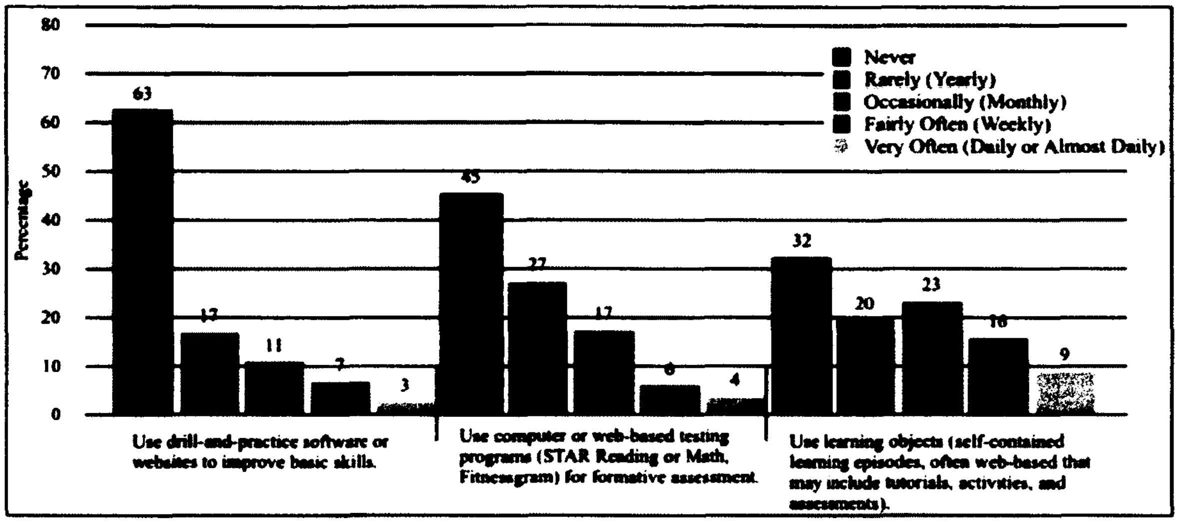

Figure 34. Student consumptive technology uses in the classroom (N= 704, 705, 695)

Some similarities and differences are indicated in the teacher and student responses. Teachers reported student use of visualization tools and use of online social science data at about the same rates with about 28% of teachers reporting occasionally use or use more frequently. They reported students using simulation programs to demonstrate complex concepts at an increased rate of 46% using these teaching tools occasionally or more often. Presentations by students to an audience outside of class but related to topics studied, followed, with 44% of teachers reporting occasional or more frequent use. Sixty percent (60%) of students reported that creating presentations monthly or more frequently was a classroom use of the laptop, in and outside of class.

The use of the laptops for student communication purposes had 58% of teachers reported having students use email occasionally or more often with others outside of school related to classroom activities. Use of social networks by students for collaboration related to learning was much less with 14% of teachers reporting weekly or more and 60% never using the applications for those activities. Seven percent (7%) of teachers reported that student worked collaboratively with students from other regions with 60% never using this strategy. Correspondingly, 39% of students reported using email for learning related activities with people outside of school occasionally or more often. Seventeen percent (17%) of students reported using social networks for class related purposes and 56% reported never using the applications.

Twenty-four percent (24%) of teachers reported that they had students use a wiki or blog created by the teacher occasionally or more often. Eighteen percent (18%) of teachers had students create original content for a wiki or blog to demonstrate what they had learned occasionally or more frequently. Nineteen percent (19%) of teachers had students contributing to web based communities related to classroom topics. Around 60% of all teachers reported they never had students participating in these activities.

Forty-five percent (45%) of teachers reported that students used sound-editing software to create custom music for project occasionally or more often as did 34% of students use of photo-editing software. Forty-five percent (45%) of students were reported to create an original digital story as often. Thirty-three percent (33%) of students were reported to use online survey tools to conduct original research and computer based data analysis occasionally or more often. Teachers reported that 34% of students in their classes used online comic builders. Comic builders and online survey tools were reported as never used by between 42-45% of teachers.

Teachers reported student use of the implementer role of technology was more broadly spread in classrooms. Student creation of published work with a word processor or publishing program was reported occasionally or more often n 72% of classrooms with 46% at lest weekly and 27% daily. The teacher reported use of spreadsheets by students at a decreased rate of 44% occasionally or more frequently, decreasing again to 37% for the use of databases. Students reported these uses at approximately the same percentages. Student research through search engines was reported by both teachers and students occasionally or more frequently at approximately 78% with about 25% participating daily.

Drill and practice software and computer based testing was reported to be used by students from around half of the teachers. Both were reportedly used by approximately 30% of teachers monthly. Student use of learning objects with self contained lessons, activities and tutorials were reported to be used by 63% of teachers, with 38% of them reporting using the objects monthly. When student responded to the same questions, their reported use was less (drill and practice, 21%; computer based testing, 27%, and learning objects, 48% for the same frequency of occasional to very often). The percentage of teachers reporting never using these strategies came to the following percentages: 27% for drill and practice, 25% for computer based testing, and 17% for learning objects while the percentage of student reporting never using them were 63% for drill and practice, 45% for computer based testing, and 32% for learning objects.

Figure 35 shows the percentages of Internet use required of them by the school reported by students in different subject areas. Internet use with the laptop assigned to the student in a one to one laptop school is something that would be expected. Highest Internet use in school was in English/language arts, followed by science and then social studies. Lowest uses were in vocational education classes and cultural studies. At home use for each subject was less than half of what the in school use was reported. The requirement of Internet use at home may be one of availability in some of the communities surveyed. A study by another member of the Tech Cohort will address questions around the use of the internet in this sample of one to one laptop schools in communities (Lloyd, 2012).

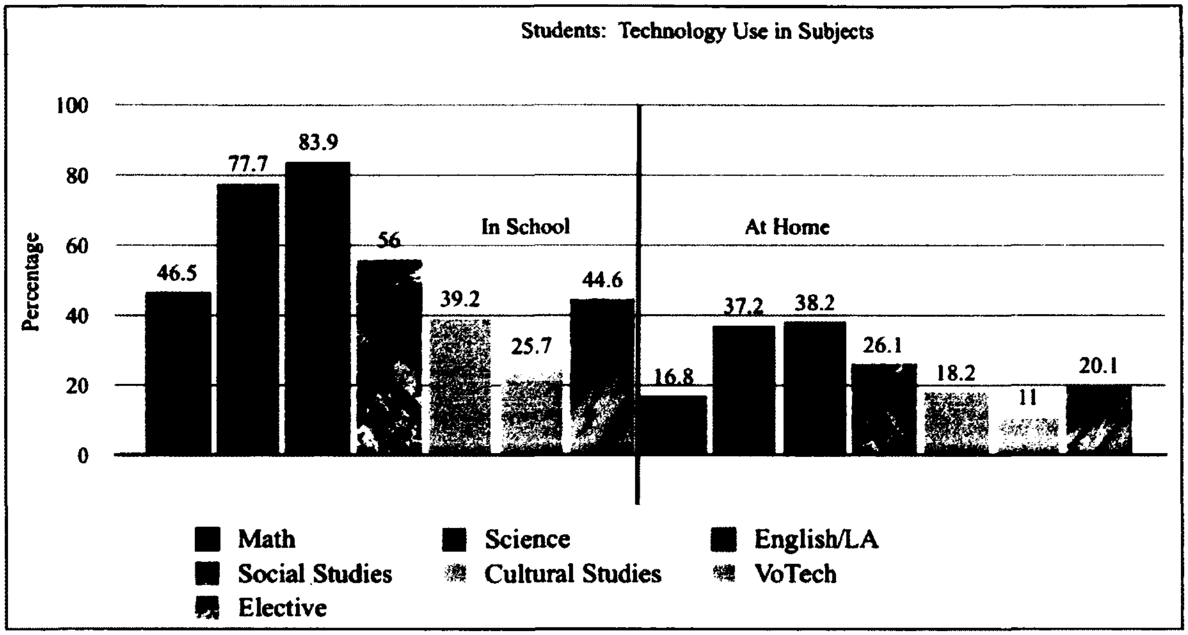

Figure 35. School subjects using Internet at school and at home reported by students

4.1.5 Research question five.

"What are teacher perceptions regarding the implementation of technology in one to one laptop programs?" Teachers were asked to give their perceptions of how the implementation at their schools was going through a series of questions regarding leadership, articulation of goals and policies, curriculum alignment with the program and systems of support.

The majority of teachers voiced that the goals for their district's laptop program had not been clearly articulated to teachers and students (58.5%) with 45.8% of teachers indicating they were unaware of the district goals for the project. This represents a substantial communication gap where teachers may have to make decisions about the direction of the laptop program individually or at the school level. The perceptions of how the laptop program was administered and supported at the school level was more favorable as visualized in Figure 36.

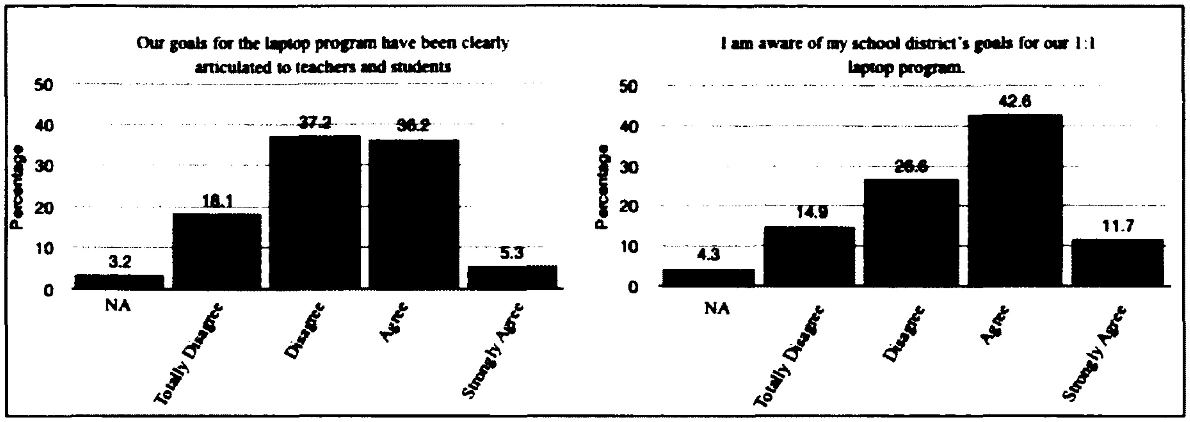

Figure 36. Teacher perception of district goals for the one to one program

Sixty-seven percent (67%) felt they got the amount of administrative support they needed to optimize the laptop program and 69.2% felt they received the technical support for optimizing their laptop program as indicated in Figure 37. Approximately one-quarter of teachers of this sample felt that more support was needed.

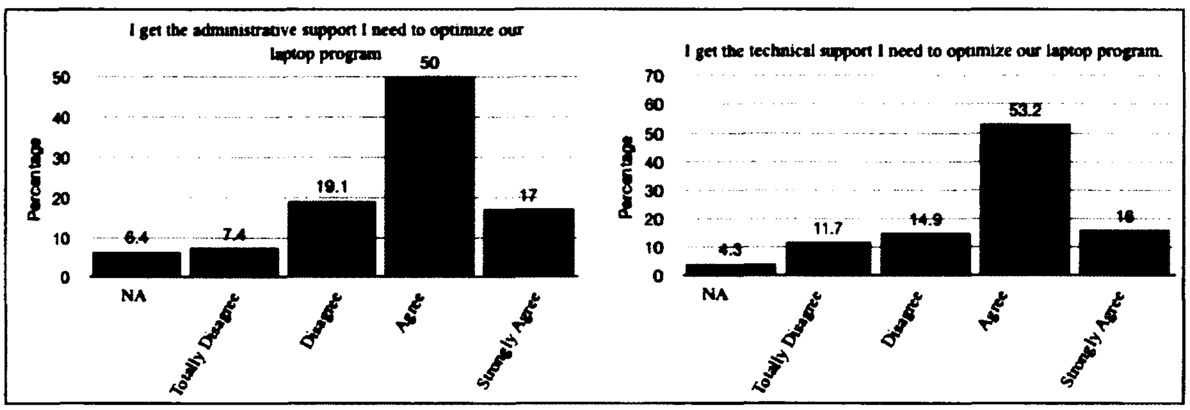

Figure 37. Teacher perceptions of administrative and technical support

About 94% of teachers indicated they were aware of the school's acceptable use policy. When asked whether school policies supported the learning activities students needed, a lesser amount (approximately 75%) agreed or strongly agreed. Figure 38 shows the frequency in percentage of those responses.

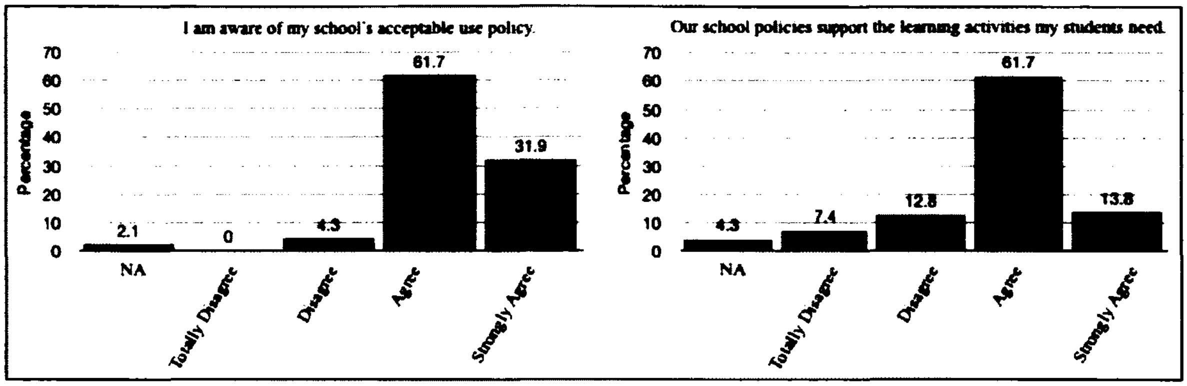

Figure 38. Teacher perception of one to one policies

Figure 39 demonstrates that 66% of teachers indicated that they felt the district's policies supported students taking the laptop home to extend the school day. In support of this findings, approximately 66% of students (n=476) confirmed that they took a laptop home, excluding those who responded as the question being not applicable. Table 47 presents those responses.

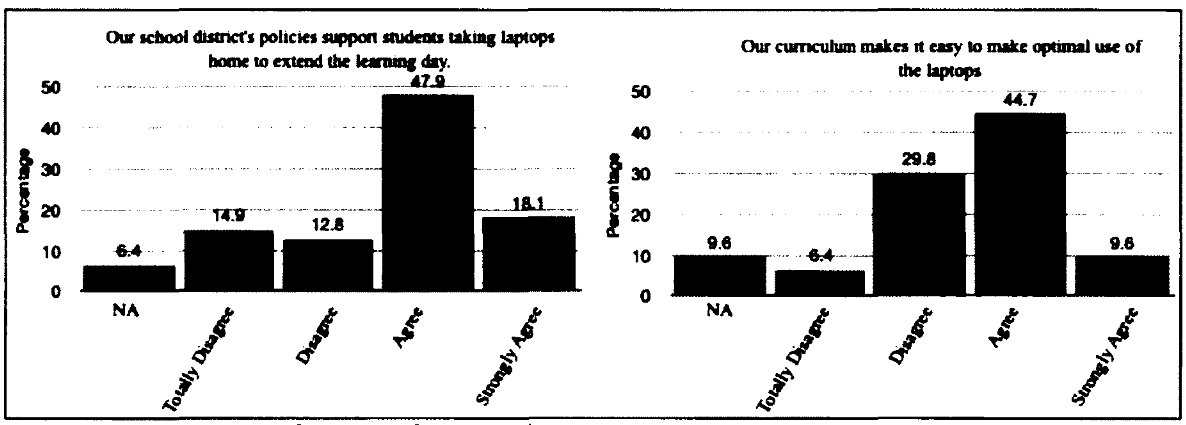

Figure 39. District policies and curriculum support

Table 47:

Students taking school laptop home

Do you take laptop home?	Frequency	Percent
Yes	476	65.7
No	179	24.7
NA	70	9.7
Total	725	100

This finding is indicative of schools that have responded to challenges as in other implementations such as abuse of and damage to laptops and parental concerns of unmonitored Internet usage at home (Shapley et al., 2010). More research is required to understand the exact nature of the policy change of allowing students to take the laptop home to that of the laptop remaining at school.

Teachers were split in their perception of whether the curriculum supported optimal use for the laptops (53.3% indicating Agree or Strongly Agree).

About 59% of teachers thought there was enough professional development available to them. Teachers were split on whether there was enough professional development that met teachers' needs (50% Disagree/Agree) indicating that a emphasis on professional development, even in a mature one to one implementation, may be an on-going component for attention. Figure 40 presents the responses of teacher's concerns about district sponsored professional development.

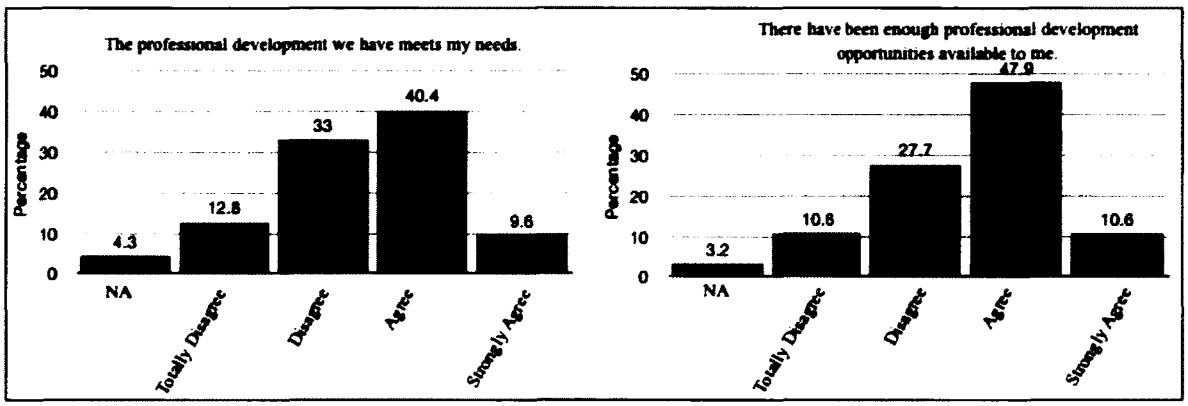

Figure 40. Teacher perception of district professional development

4.1.6 Open-ended questions.

When asking teachers about troublesome aspects of the one to one program in open-ended questions, open coding of responses was accomplished by categorizing the meaning of short responses. These responses ranged from short phrases to two sentences in length. These short phrases were organized into themes in similar categories. The thematic coding of the question, "What is the most troubling aspect to the one to one laptop program at your school?" is presented in Table 48.

Table 48:

Themes for "the most troubling aspect to a one to one program at school."

Teachers: What is the most troubling aspect to the one to one laptop program at your school?						N=72			
Themes	N		N						
Sustainability	5	Funding	5						
Support	18	Lack of PD	7						
		Technical Support	8						
		Lack of admin support	2	Lack of teacher accountability	1				
Teacher Impacts	12	Too much extra work	1						
		Management Issues	11						
Student Behaviors and Consequences	44	Distractions	19	Social Networks	7	Chat	2	Video	2
				Games	3	Inappropriate Sites	4	Music	1
		Damage Issues	4						
		Lack of student accountability	3						
		Student Misbehavior	18						

Responses coded into the theme "Student Behaviors and Consequences," by far dominated this question. Teacher responses indicated that student distractions into areas that were not seen as learning activities, misbehaviors through lack of responsibility, and not following rules of the program, were considered most troubling. This analysis in Table 48 adds to the information gained from the teacher LoU in that the most significant concern of teachers was maximizing the use of laptops by students and in the SoC of Consequence with the impact on students a primary concern. The reported use of the laptop by students in off-task behavior in the theme of Student Behaviors and Consequences and would be a concern if the maximization of use for learning is primary.

The theme of Support was quoted as being the next most troubling area. Technical support and lack of appropriate professional development were the most significant aspect of this area. The theme of Teacher Impacts involved management issues of the logistics of the laptop program and also indicated the amount of work that some teachers were putting into the program. These responses taken together, and related to the responses outlining the reported student distractions, may lend support to the ideas that more professional development in that area of classroom management, digital etiquette, and the development of productive and positive learning communities may be appropriate.

Some concern was reported in sustainability of the one to one program in the area of funding. The need for replacement hardware seemed to dominate this theme as well as the ability to expand the program to all children in the school.

Open coding was also applied to the question “What is the best reason for a one to one program?” to confirm quantitative findings and gain deeper understandings of the question. Five main themes were revealed in Table 49.

This analysis leads straight to positive impacts seen for students, again the primary concern of the teacher sample from the SoC. The most teacher responses fell into the theme of student learning impacts of the one to one (n=28) and included aspects of enhanced learning opportunities of use of higher order thinking skills, content and process learning, creativity, enjoyment and relevance of learning and high quality work.

Table 49:

Themes for teachers' "best reasons to pursue a one to one laptop program."

Teachers: What is the best reason for pursuing a 1:1 laptop program?								N=70			
Thematic Response Frequency	F		F		F		F		F		F
Student readiness for work through technology	14	Technology use for the work force	5	Readiness with work related skills	9						
Increased measures of student engagement	20	Engagement	5	Extended school day	3	Student life and learning style	12				
Student learning impacts of one to one	28	Higher order thinking skills	10	Demonstrate learning	2	Process learning	1	Enjoyment of learning	2	Creativity of learning	2
		Learning content	7	High quality of work	1	Learn in new ways	1	Relevancy of learning	2		
Access impacts to students	22	Access to resources	17	Equity	2	Increased opportunities	1	Student efficiencies	2		
Teacher impacts of one to one	6	Effectiveness of teaching	4	Teacher access to resources	2						

Access impacts to students to expanded learning opportunities through improved resources and equity was the second most pronounced theme voiced in 22 teachers quotations. Access to expanded resources for students, equity between students, and student efficiencies were cited.

Teachers reported that increased measures of student engagement were almost equally important to access impacts. Student engagement in learning, the alignment of the student's life and learning styles within learning activities, and the ability to extend learning beyond the school day, were quoted and coded. Better effectiveness of teaching and increased access to resources were impacts also cited by some teachers as being the best reason to pursue a one to one program.

When responding to the question "What is the learning activity you are most proud of that you have used with students?", teachers with answers were coded and presented within the themes of Table 50.

Table 50:

Themes and coding for learning activity teachers are most proud of

What is the learning activity you are most proud of that you have used with students?						N = 63	
Themes	F	Codes					
Demonstrations of Learning	30	Comic Builders	4	Podcasts/ Videos	3	Word Processing	4
		Presentation Applications	18	Sound Editing	1		
Participation in Learning Activities	19	Wiki/ Blog	8	Learning Applications	8	Webquests	3

Student readiness for the workforce was another theme that developed through the teacher responses. Students having technology skills that readied them for the work force and for post-secondary education were deemed important as well as students having life skills to live in an increasingly technology dependent world.

Positive student demonstrations of learning through technology were reported most often. These demonstrations were those that would fall into a student role of "producer" using word processing, presentation software, multimedia, and comic builders. The use of presentation software predominated this theme. Participating in learning activities or lessons that involved technology for delivery or enhancement of instruction content was also a theme that was synthesized from teacher responses that they were most proud of. Wiki/blogs, the use of the web as a resource or learning activity were included in this theme. These applications would fall into roles of communication through technology and the consumption of content.

The themes of this question were broken down into the roles of TCU that a teacher would play in making these assignments. The roles played are presented in Table 51.

Table 51: *Teacher roles in TCU based on learning activity most proud of*	
What is the learning activity you are most proud of that you have used with students?	N = 54
Teacher Role in TCU	
Communicator	3
Contributor	3
Producer	27
Implementer	12
Consumer	10

The question "What is the learning activity you are most proud of that you have used with students?" also indicates a value judgment by the teacher of what an exemplar would be to demonstrate the use of technology in the classroom. Using the responses to this question reveals insight into the LoU of CBAM. These categorizations of LoU levels reflect assumptions that teachers would give the level of technology use that would best demonstrate their achievement. By applying the LoU framework to teacher responses, three categories of LoU contained all responses. The following table indicates the LoU, each level's indicating behaviors and the frequency of coded responses for that level. Table 52 aligns LoU to student technology uses teachers are most proud of.

Table 52: *Levels of LoU suggested by learning activities teachers are most proud of*			
What is the learning activity you are most proud of that you have used with students?			N = 63
LoU Level			
Mechanical	III	Actively engaged with the innovation through experimentation.	11
Routine	IVa	Mastered the innovation and has sufficient support.	27
Refinement	IVb	Reflection and assessment of how the innovation benefits clients.	16

When adding these responses to the mean responses of LoU presented in graphic nature previously in this paper, these teacher responses are confirming to the general technology proficiency. Caution must be taken in this analysis as descriptions of the types of student demonstration of technology were self-reported by teachers and do not have a standard of quality established. They only reflect the feeling of the teacher on what made them most proud when their students used technology.

When looking at the CBAM Stages of Concern through questions 9.5 through the teachers' number of years at the current school, the following profile was apparent as indicated in Figures 41 and 42.

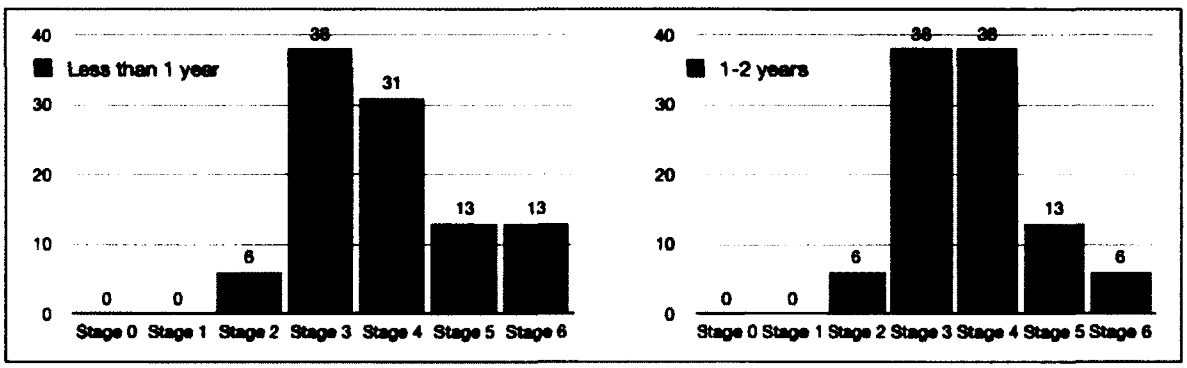

Figure 41. Teacher SoC to number of year at current school: two years or less

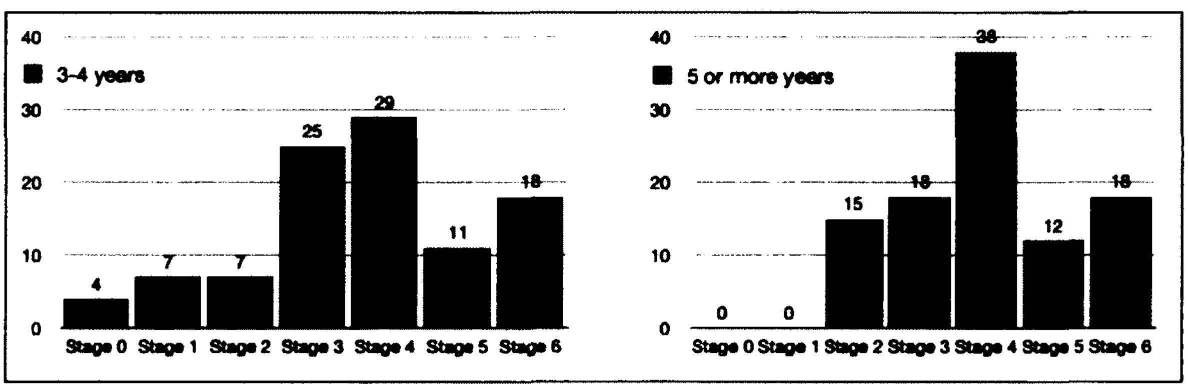

Figure 42. Teacher SoC to number of years at current school: 3 or more years

Teacher confidence of using computers for specific tasks are indicated in Stage 4, and are the highest level of responses in all groups except teachers in the first year at their school. Teachers who had less experience in their current one to one school showed the highest responses of beginning to understand how to use the technology and integrate it into their lessons. The more experience the teacher had in the school, the more understanding of using the laptop as a tool was indicated

4.2 Chapter Summary

This chapter presented the analysis of quantitative and qualitative data. A variety of statistical measures describe and evaluated the survey data to better understand aspects of the one to one programs indicated through the teachers and students in this sample. Quantitative measures were used to present findings relating to the five research questions of this study. Qualitative data from open-ended questions was coded into themes in order to further understand qualitative results.

Chapter 5: Conclusion

This study was designed to gain an understanding of teacher and student perceptions of their use of technology in their personal life and classroom use. Uses of technology in teachers' professional practice and their concerns with implementation of the one to one laptop programs were also gathered and analyzed. This final chapter provides a summary of findings, a discussion of the results and offers recommendations for further study.

5.1 Summary of Findings

Quantitative and qualitative research findings were presented in chapter four relating to five research questions. A brief summary of those findings relating to each question follows.

5.2 Research Question One

How do teacher perceptions of their technology use in the classroom vary based on teacher demographics? Summary demographic findings include:

- Equal percentages of the population sample were in the 30-39 age group and the 50 to 59 age group (30.9%).
- About 72% (68 of 94) of teachers had more than 6 years of teaching experience.
- Eighty six percent (86%) of teachers surveyed had all of the time they have experienced in a one to one learning environment in the current school they were teaching in.
- About 62% of teachers had 3 or more years of experience teaching in a one to one school.
- A little more that one quarter (26.6%) of teachers indicated they spent 0 hours of professional development on their own time while another 29.3 of teachers reported they spent 27 hours or more on their own professional development.
- Close to 40% of teachers reported district sponsored professional development of less than 8 hours while 27% (19 of 94) reported district professional development of more than 40 hours.

When considering the demographics of the sample, findings are relevant to the understanding of the one to one laptop program studied. The demographics of gender, age, ethnicity, length of tenure as a teacher in the district, or at the current school, did not show a statistically significant difference when considering levels of adoption measured by frequency of technology use and levels of technology proficiency in the classroom. A generalization that an older person is more averse to integrating technology into instruction is not borne out in this study in that there was no significance between age and proficiency of technology use. This supports the findings of previous studies in that frequency of technology use did not differ significantly from novice teachers to those with much more experience (Grunwald, 2010a).

5.2.1 Professional development.

- Fifty percent (50%) of teachers responded that the professional development provided them met their needs.
- About sixty percent (58.5%) of teachers reported that there has been enough professional development available to them.
- Statistical analysis indicated that the amount of professional development, both personal and district sponsored, were significant to levels of teacher classroom use as measured by TCU. This finding has implications to school leadership in implementing a one to one laptop program.

Different school districts offer a varying amount of professional development over the school year. A majority of newer teachers had less than 8 hours of professional development opportunity with about 17% of teachers reporting 0 hours of opportunity. When pursuing a complex innovation with critical components, the need for acknowledging change teachers need to make and be supported in through adequate professional development, needs more attention than one or two days of this opportunity for instructional strategies to be integrated within a curriculum model. While time alone has not been shown to have direct effects on impact measures of professional development of technology integration, the time and opportunity to learn was related significantly to impacts of content focus, active learning, and collaboration (Ingvarson, Meiers, & Beavis, 2005).

In another study of the components that make professional development effective, findings were presented that teachers participated in an average of 35 hours in professional development activities targeted at reform, versus 23 hours for traditional activities (Garet, Porter, Desimone, Birman, & Yoon, 2009). It has been demonstrated throughout this research study that teachers move through stages of technology adoption over time providing richer and deeper learning experiences as they learn. When new teachers enter this type of learning environment, they deserve to have the same opportunity of movement through stages as ones who have had some longevity within a program. Time and resources are important aspects to consider if teachers are expected to incorporate technology into learning activities in meaningful ways.

A number of teachers participated in 27 or more hours of professional development on their own outside of school time (29.3%) while another 26.6% of the sample group reported 0 hours of time spent on their own professional development. This finding may indicate that the personal professional development activity of some teachers may not be targeted to school district goals.

Recommendation: The amount of time spent by some teachers in their own professional development activities with technology may be more productive for the school district if there is encouragement to teachers to pursue their own courses of professional development targeted and aligned toward goals of the district.

This model could better maximize the use of technology through face-to-face modeling, coaching and mentoring, on-line delivery, and social networking in areas of interest. Similarly to the idea that 21st century skills must be taught through active learning rather than presentation, teacher professional development must assume those attributes we know make for good instruction: active learning, regular and ongoing, with appropriate scaffolding.

Several Alaska school districts include coaching and mentoring as a integral aspect of professional development (Eberhart, 2012). This coaching and mentoring model may be with a mentor teacher within the school or vendor specific professional development. This model assists the teacher in planning for instruction, delivering the instruction with assistance in varying levels of involvement from the mentor, or assessing the outcomes of the lesson for future refinement.

5.3 Research Question Two

Do teachers' perceived levels of uses in their personal and/or professional practice lives relate to levels of technology uses in the classroom? Summary findings include:

- Teachers' personal use of technology as measured by the TPU index was moderately correlated related to use of technology in the classroom as measured by the TCU index.
- Measurement of teacher professional practice by the TPP index by a regression model was found to be strongly predictive of teacher classroom use (TCU).

This finding has much implication in considerations to the hiring practices of school leadership when looking for teachers who can effectively bring technology integration to the classroom.

Recommendation: Placing an increased importance on sections of a teacher's resume outlining professional affiliations and presentations concerning technology in education to other teaching professionals might assist in determining technology adoption in the classroom. The effort taken by a teacher to be involved in conversations with colleagues through online means or conference attendance would be a consideration. Asking a teacher to present their favorite technology application toward professional practice or in instruction to an interviewee may be a good indicator of the use of technology in the classroom.

5.4 Research Question Three

What is the level of adoption of the one to one laptop as measured by the framework of the adoption of innovation, the Concerns Based Adoption Model (Hall & Hord, 2011)?

- Self reported teacher concerns through the SoC of the CBAM showed peaks in collaboration and refocusing effort with consequence for the end user following close behind.
- Teachers reported levels of use through the LoU of the CBAM indicated peaks in refinement (maximizing student use of the laptop) and routine (teachers reporting comfort in teaching with the laptop but not putting much effort into use of the laptop).
- The overall results of the CBAM process revealed characteristics of a mature one to one laptop program. Self reported teacher concerns indicated high impact toward the end user (the student) with tendencies for those concerns to be somewhat under realized in the levels of technology use in the classroom and the routine that has been established over time. This routine attitude leaves room for teacher concerns of personal nature and management issues to become elevated. These elements could have aspects considered "distractions" to the overall concern of the high impact to the student of the program, which is supported by teacher responses to questions related to their concerns.

The use of the CBAM model and the relationships explored between other frameworks partially utilized in this research (the ACOT Evolution of Thought and Practice and the Diffusion of Innovation) indicated a generally upward trend of concerns of teachers to the higher stages of the CBAM in Stage 4 Consequence to Stage 5 Collaboration to Stage 6 Refocusing. While these teacher concerns toward the desired consequences were evident, teachers' reporting of levels of proficiency generally indicated that Stage 5 and 6 were perceived at lower levels of teacher accomplishment as measured by the CBAM LoU and that Stage 4a Routine and 4b Refinement were more prominent. Stage 4a and 4b LoU indicate that teachers considered the use of the technology as routine, not needing much effort, and teachers were looking for ways to maximize the use of the technology with students. While having students first in mind is a very desired concern, the idea of seeing the laptop as routine within the classroom could be of issue when considering the modest levels of uses reported by teachers in the classroom in certain areas (especially in communication and collaboration) and when considering responses from students regarding the same uses. Question four provides further findings in this regard.

The report of Ohler, (2011) to the Consortium for Digital Learning suggested there was a need to deepen the understanding of participants' concerns about its one to one laptop program. This report is useful in understanding the movement of adoption of the one to one laptop program over time. If applied to the CBAM framework outlined in this study, this movement would be described as movement from Stage 4 Consequence to Stage 5 Collaboration to Stage 6 Refocusing. This finding is substantiated in the stage of concerns reported by the teachers in this sample.

The use of a framework to measure technology adoption has been substantiated through the literature review and research of this study. The use of the PTP (with LoA measuring self reported frequency of technology use and levels of proficiency) seems to provide a good measure of technology adoption in the classroom for a group of teachers within a program. The professional practice index of the PTP presents a strong correlation to classroom use, therefore a streamlined survey may be practical for administrations to indicate progress in levels of adoption. The framework of CBAM also provided information that gives teachers a voice toward the one to one initiative and helps to determine their concerns.

Recommendation: In that the CBAM is a well-substantiated and validated measure for the adoption of an innovation, this research indicates that its use along with the PTP for LoA could be a comprehensive method for measurement of effectiveness for a one to one laptop program in our schools.

5.5 Research Question Four

How do students' and teachers' use technology use differ in personal and classroom use?

Personal use

- The use of the laptops was more prevalent in English/language arts classes, science and social studies. Math was the core content area which least use technology in the classroom.
- Ninety-nine percent (99%) of teachers reported using email in their personal life weekly or more with only 58% of student reporting the same usage. About 23% of students did not use email at all.
- Teachers used blogs and RSS feeds at least double the rate of students.
- Personal social networking was used by about 71% of students at least weekly compared to 32% of teachers reporting the same level of usage.

Classroom use

- About 60% of teachers did not use social networks in class, develop work for students to collaborate with others outside of class, use wikis or blogs for learning activities or have students contribute to web based communities.
- Higher percentages of teachers reported students producing work through sound or photo editing software (approx. 45%), video production (42%), presentation software (44%), and comic builders (33%) occasionally or more often.
- Teachers reported students used consumptive uses of drill and practice software (52%), web-testing (51%), learning object through tutorials and activities (52%), and implementation of word processing (46%) and web based research (47%) as the most reported student uses of technology in class occasionally or more often.
- Students reported that the most used applications in school were presentation software and word-processing followed by use of learning objects and spreadsheets.
- Lower levels of use of communication and collaboration strategies for students were noted in teacher reported uses of technology in the classroom than students report. These lower levels may be due to teachers' level of

proficiency, training or capacity. Other factors such as Internet capacity, server availability for wiki/blog hosting, or even connections with outside instructors could limit these type of strategies. More research into these areas may be warranted.

5.6 Research Question Five

What are perceptions of teachers regarding the implementation of technology in one to one laptop programs?

- A little under sixty percent (58.7%) of teachers reported the goals for the laptop program had not been clearly articulated.
- About forty-five percent (44.8%) of teachers report they were not aware of the district's goals for the laptop program.
- Sixty-seven percent (67%) of teachers felt the get the administrative support to optimize the laptop program.
- About 69% of teachers get the technical support they needed to optimize the program. Almost three quarters of the teachers responded that their school's policies supported the learning activities students needed.
- About 66% of teachers indicated that district policies supported taking the laptop home for extended learning. Sixty-six percent (66%) of students confirmed that they are able to take laptops home.

While educators were generally supportive of their school-based support systems (technology support, school leadership), it was apparent that many teachers did not have clear understanding of the district visions (57%) and goals (45.8%) for their one to one laptop program. The concerns of teachers reported in the CBAM also indicated, that while the peak concern was to collaborate and refocus, that the actual reported levels of use peaked in areas of routine use of technology and maximizing the technology for the end-user (student). There could be many reasons for these findings within and beyond the laptop implementation.

When no clear goal or vision is provided for an innovation, teachers are left to their own devices to determine what is important. In another study, teacher responses were found to be emotive when left to their own interpretations of the one to one project, (Dalgarno, 2009). When goals are unclear, distractions from those goals may start to gain perceived importance and become the focus rather than more important benefits of the program. This may be indicated in this research study through the perceptions of teachers who report the most troublesome aspects of the one to one programs as being student misbehavior and distractions. In this research, teacher concerns of personal impacts of the innovation and management of the program were elevated to levels higher than what would be expected in the ideal high impact concern user.

Fidelity of implementation were topics in several evaluation studies (Russell et al., 2003a; Shapley et al., 2010). If there is to be fidelity of implementation, the more specific the goals for implementation, the easier fidelity is to measure. If there are unclear goals or those goals are not well communicated to the implementers, teachers in this instance, then the odds of fidelity of implementation to what was intended are small indeed.

One of the issues that plagues rural schools in Alaska is that of transience of educational certified staff. This is exemplified where turnover of teachers and principals from the districts in this study ranged in percents from the high teens to the low 40s (Hill & Hirshberg, 2008). This trend has been consistent over the years, with an average of over 20% turnover of Alaska teachers from 1999 to 2007.

In the sample for this study, a large percentage of teachers had been involved with the one to one laptop program in their school for over 5 years (36.2%) and 72% had 3 or more years of teaching at the current school. This is in some ways contradictory to the idea that transience of teachers is a central issue to implementation of the laptop program.

What may be more of a detriment to implementation of the laptop program is the turnover of administration: averaging over 25% of principals during the same time period each year (Hill & Hirshberg, 2008). From 2002 to present, the average turnover rate of Alaska superintendents has been 23.6% per year (Johnson, 2012). These general numbers indicate that the turnover in school leadership is as significant as teachers in our one to one schools. When implementing a 2nd order change such as a one to one laptop program, this turnover can lead to missing the lessons from implementation challenges for any school change that might have been hard learned. Administration and leadership were not included in this study, so more information is needed to determine implications of this transience.

Recommendation: Transience of teachers and administration also means that some of the most consistent players within the one to one programs might very well be the students and classified staff. Their involvement in developing, implementing, and sustaining the one to one program should be enlisted, as their experience is one that brings a unique stabilizing perspective it. This research included only staff that was responsible for teaching a class. The inclusion of classified staff in such a study would bring a richer perspective to the findings.

If one aligns the issues of routine complacency of technology use, lack of understanding of district vision and goals, and teacher and administrative transience, the development of a clear, well-articulated, and well-documented plan to sustain programs that is actively used to move the one to one program forward would be a strong recommendation for districts to consider. Including and listening to teacher voices and their concerns on a regular basis would become even more important.

Recommendation: This concentrated effort by administration to continually articulate and communicate the vision and goal for a laptop program may help teachers to not only focus on the goal of bringing high impacts to student learning but to indeed accomplish that goal through high levels of use in rich learning activities. If communicated well over time and institutionalized with those who have longevity of employment or relationship to the district, this plan may be a lasting guide for the use of technology.

There are indications through open-ended question responses regarding the most troublesome aspect of a one to one laptop program that some instructors may put challenges before opportunity by limiting obvious learning advantages of using technology due to challenges of student misbehavior with the use of the laptop. The idea of distraction from "learning" is one that may be described more clearly as a distraction from the learning activity prescribed by the teacher. Teachers that scored at the higher levels of LoA were ones who indicated that students were using Internet based methodologies for learning, many being the same methods perceived as distractions from learning by others at a lower LoA. Management issues were also cited as troublesome to some teachers.

Recommendations: More professional development designed to address these types of barriers may be indicated to move teachers into higher LoA levels of frequency of use and technology proficiency. The clear communication of district goals in technology may help teachers who pursue professional development on their own to make a difference in the technology adoption within their classrooms.

5.7 Limitations

When putting the findings for this research into context of the direction of technology integration and infusion into Alaska education, several assumptions must be addressed. The context of one to one projects through Alaska has addressed common elements of such a project as being present. The definition that was developed for this study attempted to provide a common infrastructure of support and implementation of the Alaska one to one experience. Commonalities of programs included program grade levels of implementation, hardware, software packages, electrical and wireless network capacities, the addition of professional development directed toward teacher technology proficiency and the integration of technology into the classroom, the availability of technical services, and a minimum standard of policy of laptop use. Even though these commonalities were present, there are mediating circumstances that cannot be controlled.

Most of the Alaska one to one programs are in rural/bush school districts. The nature of technology implementation in a rural setting cannot take into consideration all of the local conditions that are unique to the setting. These conditions may include isolation due to lack of normally accepted transportation systems (i.e., roads), extreme weather conditions that may affect not only what transportation is available but also contribute to aspects of Internet access.

Though the survey was comprehensive in nature, some items were not included such as the availability of school internet access and speeds, the presence of student email addresses, and the capacity of providing school based wiki/blogs through school servers. The availability of school internet could be an important variable. Quality and dependability of internet access may be a consideration of the types of uses teachers and students use at home and in school. The difference of the availability and type of broadband access may be a condition that affects technology uses in the classroom setting. The discussion of the complexities involved with the availability and amount of bandwidth for schools is beyond the scope of this research. Many times the bandwidth availability is a function of funds the school district can allocate to a school. In Alaska this price of bandwidth can be a detriment in allocating enough to a school so that many students can access the internet at the same time, thus limiting teacher options for using internet-based applications in learning. Even when broadband availability is plentiful in a school, the latency of satellite delivery of broadband can affect the functionality of educational applications that depend on off-site servers. These topics are the central questions of the research of Lloyd, (2012)

The difference in local community culture is another condition present in any large sampling of Alaska rural schools. Given the expanse of the geography and distinctly different cultures of the communities that may be over 1000 miles apart, the generalization of findings must always be framed within that context.

5.8 Implications for Further Study

Given the similarities of the one to one programs implementations and common support challenges in any one to one implementation, this study should be one that researchers in other areas can glean nuggets of information that will assist in future studies. Some of those implications for further study that would help clarify findings of this study are presented here.

More in-depth analysis of the demographics of individuals of different stages of concern and technology proficiency, as measured by the indices developed in this research, would be of interest to those who implement one to one digital learning projects and who would desire to understand the nature of technology adoption in a one to one laptop setting.

Differences in professional development models, types of training, and their efficiencies could be explored. A change of professional development models to include time where a teacher could extend and apply learning in a personalize venue and incentivized in some manner could be worth the effort to reconsider the expensive and difficult to schedule "days of PD" of a traditional model.

Further study of the combined use of the instruments utilized in this research study with a more in-depth factor analysis to streamline and validate the LoA may give school districts better tools in which to use with teachers over time.

More research into the reasons into the use of technology in the content areas is indicated. Variables of typed of application, applications suitability, availability of enabling technologies through district support such as email for students, wikis, blogs, and content programs, and why there is not more use of technology in math are areas for further research.

A more definitive study on transience of administrators and teachers in and out of one to one program would provide more exact data to compel districts to document their one to one programs with an articulated vision and goals as well as a professional development model that works to sustain the program.

5.9 Summary

The goal of this research was to establish credible data as a baseline of one to one laptop programs in Alaska high schools. Findings within this study support findings found in previous studies of one to one implementations (Bebell & Kay, 2010; Becker & Ravitz, 2001; Dalgarno, 2009; Donovan et al., 2007; Grunwald, 2010a; Shapley et al., 2010). The establishment of a level of adoption (LoA) measuring levels of use and technology proficiency by teachers; measurements of technology adoption through the Concerns Based Adoption Model, a well defined framework of innovation adoption; the inclusion of teachers' voice on the one to one implementations at their schools along with student measures of technology use were conducted through the analysis of the quantitative and qualitative measures gathered through an online survey. The data revealed that, though some one to one programs are entering into their 6th year, teachers reported much opportunity for school districts to advance the effectiveness of the one to one programs already established, and to learn how to improve on implementation of new programs.

The discussion of findings may be helpful in determining systemic methods of assessing one to one programs, developing hiring practices that may enhance such programs, and to better understanding the importance of relevant professional development activities for teachers. School administrations may gain from the understanding of developing effective and efficient support systems in areas of communication, policy, professional development and technical services.

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Appendix A: Cohort Experience

This dissertation is one of four inter-related studies focusing on the digital landscape in one-to-one laptop environments within classrooms in Alaska's public high schools. Each of the four doctoral students analyzed aspects of teaching and learning in one-to-one computing environments that exist within public schools in Alaska; each approaching their own individual study from their individual perspectives. The cohort model provided a professional atmosphere for social learning (Wesson, Holman, Holman, & Cox, 1996). Wesson, et al, (1996) continue to write about the formal and informal social processing in a cohort promoting a learning environment rich in collaboration and cooperation. This has been very true for the model offered to the four cohort members over a three-year time-span.

The cohort structure and agreements within it helped to build common vision of the combined research effort and manage differences of opinion. Recommendations for a good working structure are to a) organize a cohort with similar levels of experience, b) attend to the personal dynamics of the group, c) create a culture where difference of opinion is respected, valued, and open, d) establishment of the expectation that feedback will be provided, and e) opportunities are present for informal exchange (Creamer, 2004). Even before this research was known, the Tech Cohort followed these recommendations. In addition, the knowledge of and access to the network of associates each cohort member brought to the table enabled each individual to benefit from a much larger range of logistical support in the research of individual studies.

Positive cohort experiences, specifically in preparing scholarly practitioner leaders built on each researcher's professional experiences coupled with a collaborative structure, have shown to produce higher rates of completion (Barnette & Muth, 2008). The four members making up the technology cohort exemplified this statement. There were many times the cohort did not give-up because of the consistent support of each of the members. In addition, the cohort shared common coursework, collected research data through common survey instruments using the same program population, as well as shared common committee members.

Having similarities in background and experience is beneficial for a cohort (Dorn, Papalewis, & Brown, 1995 1995). All members of our cohort had backgrounds in Alaska education, having taught many years in Alaska individually and were recognized as influencers in educational technology and Alaska education in general. Each of the four cohort members came to the research topic with previous experience and expertise, at a school, district and state levels for one-to-one laptop implementations. Each has experience working in school districts.

Larry LeDoux is the former Commissioner for the Alaska Department of Education and Early Development. During his 30 years in the Kodiak Island Borough School District, he has served as superintendent, principal, teacher, and technology director. Larry is currently retired and is working as a private education consultant.

Pam Lloyd served fifteen years in the Anchorage School District as both an administrator and a classroom-teacher. She held the position of K-12 Instructional Technology Coordinator for six years. Pam has held numerous board positions including President of the Alaska Society for Technology in Education (Holcomb, Castek, & Johnson), and President of Cook Inlet Literacy Council. She currently serves as President of the Alaska Academic Decathlon and is on the U.S. Academic Decathlon board of directors. She currently works for General Communications Incorporated (GCI). GCI is an Alaskan-based telecommunications company providing voice, video, and data communication services to residential, commercial, and government customers. Pam currently is the Director of GCI SchoolAccess, a division within GCI, providing Internet access and distance learning services for schools across Alaska, New Mexico, and Montana.

Mark Standley has served in the capacity of teacher, principal and assistant superintendent across several districts in Alaska, including the Anchorage School District. He was formerly co-chair of the State's Technology Standards group (1990-1991) and is President-elect of the Alaska Society for Technology in Education (Holcomb et al.). He currently is the CEO for a non-profit, Education 4 Leadership, focused on one-to-one implementation and supervises/teaches education research to pre-service principals for the University of Alaska Southeast (UAS) Education Leadership Program.

Bob Whicker, a former teacher, principal, and superintendent, ended his K-12 career in the Denali Borough School District, one of Alaska's first one-to-one laptop implementation districts. His journey led him to work for Apple, Inc. as a Development Executive, working with school districts in their implementation of one-to-one laptop programs across the western U.S. He currently is the Director for the Association of Alaska School Boards, Consortium for Digital Learning program, and serves on the Alaska Broadband Task Force.

Together, the members of this cohort have a plethora of knowledge, experience, and expertise in the field of technology and education. They have all known and worked with each other over the years in these various capacities, at the national, state and district levels.

Cohort groups in research bring a larger network of resources to benefit the group (Miller & Irby, 1999). Time and time again, the vast amount of experience of the Tech Cohort benefitted not only the group in its organization but each individual. The differences in perspective of cohort members enable each individual to test their theories against each other (Creamer, 2004). Just as the previous University of Alaska Fairbanks (UAF) cohort, (Atwater, 2008; Cope, 2008; Crumley, 2008; McCauley, 2008) this cohort shared the importance of the commitment to a common goal, making the research process a true community of practice through discourse, mixed methods and models. The cohort shared classes and met outside of class regularly to discuss the overarching topic of one-to-one laptops in the digital landscape of Alaska.

Each member of the cohort looked through a unique lens sharing interest in an overarching topic to research teaching and learning in the Alaska digital landscape. The four cohort members and their dissertation topics were:

Larry LeDoux's research is a mixed methods study, titled, "Polishing the mirror: a multiple methods study that examined the relationship between teaching style and the application of digital learning technologies in Alaska's one-to-one laptop programs".

Larry researched the outcome of this relationship as a key determinant in the success of strategies to create learner environments that are consistent with both Alaska Native and 21st century practices and outcomes.

Pam Lloyd's research is a mixed method study, titled, "Digital dead-ends along Alaska's information highway: home broadband access for teachers and students in Alaska's high school one-to-one laptop programs". Pam researched the Levels of Adoption (LoA) among three categories of bandwidth availability in the community for teachers and students.

Mark Standley's research is a qualitative study, titled, "Kids getting away with learning: student perceptions of a one-to-one laptop program". Mark listened to students views of learning in and outside of school structures by conducting focus groups with high school students in five schools.

Robert Whicker's research is a mixed study, titled "Framing complexity: teachers and students use of technology in Alaska one-to-one laptop high schools". Bob researched the perceptions of teachers and students in the implementation, levels of use, and concerns identified by teachers in Alaska's high school one-to-one laptop program

The relationship between each cohort members' research topic and questions related to the overarching theme is shown in Figure 43.

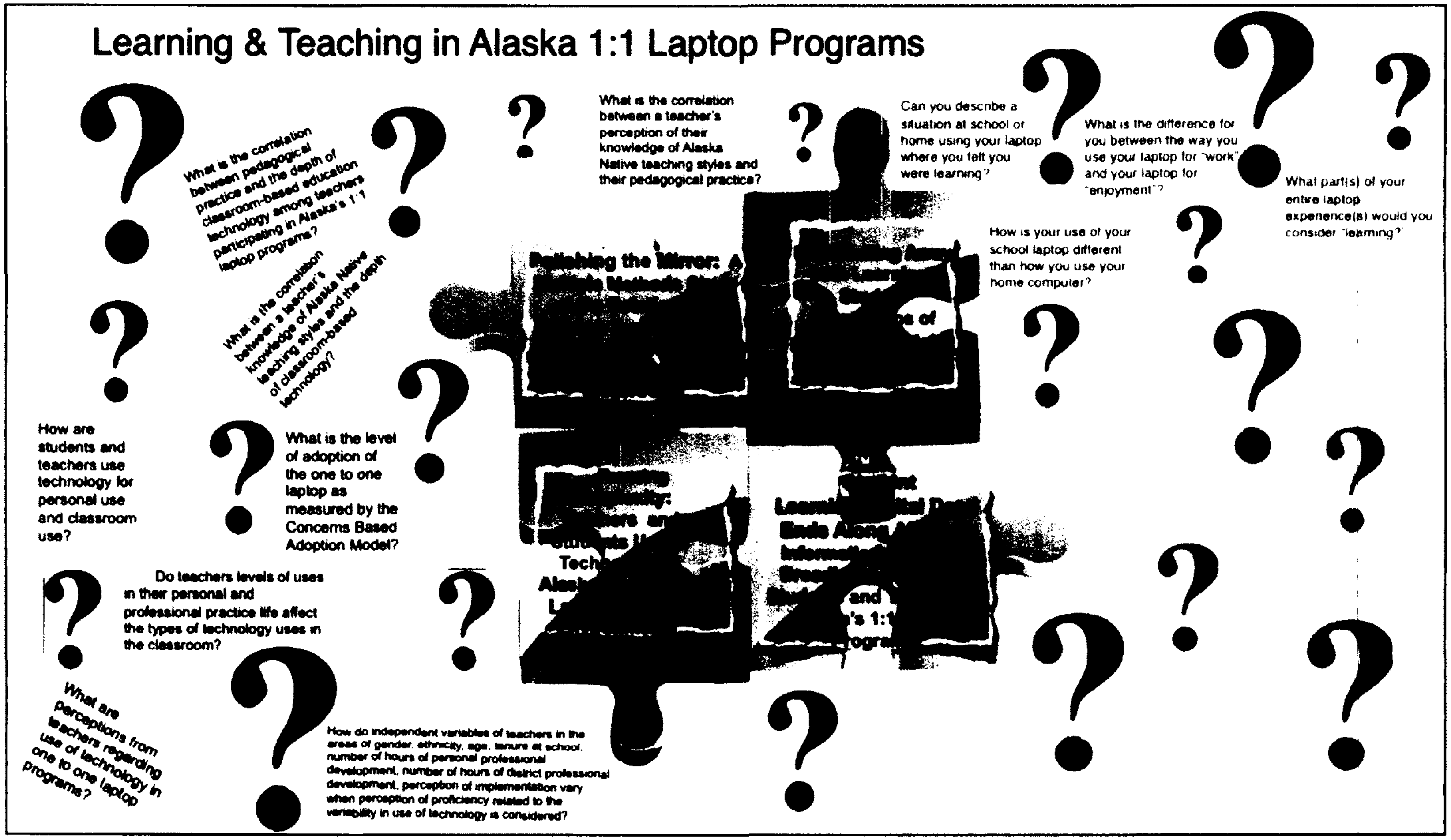

Figure 44: Cohort Research Relationship

A 215-item questionnaire for teachers, with nine open-ended questions and a 100-item questionnaire, with three open-ended questions for students was collaboratively created by three of the four cohort members. The cohort shared in the role for dissemination of the surveys to districts identified as having predefined criteria. This effort led to response rates of 40% for teachers (n=94), and 43% for students (n=725). This shared effort led to higher response rates and a much larger dataset then if the cohort had taken on the role of data gathering, individually. The fourth cohort member created questions for qualitative focus groups using input from the three other members to gather student perceptions related to questions on the online survey.

The Tech Cohort also coordinated a pilot study in January 2011 in a remote village in Northwest Alaska to test out the online survey and focus group instruments. This required part of the cohort to be at the school and part to be online to test questions, timing, and technology involved with our research gathering instruments. This team effort led to better online surveys and focus group questions, some contributed by each member of the cohort. This shared field-testing and pilot study gave the entire team more confidence and better tools for conducting the research.

The Tech cohort modeled many of the practices and roles to the cohort previous, in that this cohort developed a community of practice and a vision for shared leadership (Atwater, 2008; Cope, 2008; Crumley, 2008; McCauley, 2008). This cohort also functioned as a "knowledge mini-market" (Cope) as they reviewed literature, created meaning and shared knowledge (Cope, 2008).

For many doctoral students, the individualized, independent structure of a traditional doctoral program can lead to frustration and failure. This frustration has led 40% to 70% of the doctoral student population down the path of dropping out and feelings of failure (Gardner, 2008). For many traditional doctoral students, the transition from "consumers of knowledge to creators of knowledge" (Gardner) causes much isolation in the doctoral process (Gardner, 2008). The cohort model experience did not reflect feelings of isolation or frustration, but rather a feeling of belonging to a group with a common purpose and commitment to four members, sometimes driving simultaneously, and sometimes one at a time.

Researchers shared the idea that cohort models take on a collective personality. The cohort definitely came together with individual personality and voice. While there was not always agreement, there was support for each other throughout the process. The cohort shared a collegiality and trust to question for understanding that pushed each member into the next step of the process in becoming a more effective researcher. The benefits experienced by each cohort member in this model supported the research findings, and provided a successful learning community for each member of the cohort. The main reason for doctoral students in an Illinois university completing their programs was the support and encouragement of their cohort members (Brien, 1992).This was most certainly true for this cohort. There is no doubt that without the continued uplifting nature of our cohort members toward each other, we might be writing still. Due to the demands of the professional careers and the pressure of the demands of our doctoral programs endured by each one of our cohort members, support and understanding of mutual challenges between cohort members was crucial.

The structure of each cohort takes on its own unique identity (Dorn & Papalewis, 1997). The identity of the Tech Cohort came to be one where, as we progressed through phases of the dissertation process. Individuals interacted with each other in roles of cheerleader, "got your back" voice of reason, devil's advocate, philosopher, connector, and practitioner. Through spirited discussions between cohort members, ideas were vetted and led research into areas supportive to each individual's research.

This cohort met regularly over a three-year period. Weekly Monday night classes common to all members, overlapping working schedules during educational conferences and in airport boardrooms, and regularly scheduled teleconferences reinforced the team support of each individual. The development of a team structure where each member was valued provided informal support and the encouragement needed to persist in our research. The experiences of this cohort support the findings of the researchers cited above that the benefits of the cohort model are indeed tangible and worth replicating in other doctoral programs.

Appendix B: Glossary

Analytic tools: Devices and techniques used by analysts to facilitate coding process (Strauss & Corbin, 1998, p. 87).

Axial coding: The process of relating categories to their subcategories, termed "axial" because the coding occurs around the axis of a category, linking categories at the level of properties and dimensions (Strauss & Corbin, 1998, p. 123).

Bandwidth Speed: The measure of available or consumed data communication resources expressed in bit/second or multiple bits/second as in kilobits per second or megabits per second. Bandwidth speed is also known as the throughput of the pipe in the data transmission.

Blog: A combination of the words web log where an author makes dated entries on a discussion or information site published to the World Wide Web (Blood, 2000).

Broadband: Refers to a telecommunication signal or device of greater bandwidth and is measured in speeds. The FCC has defined broadband speeds as 786 Kbps Download to the customer by 200 Kbps upload to the Internet.

Categories: Concepts that stand for phenomena (Strauss & Corbin, 1998, p. 101).

Classroom Use of Technology: The use of technology in the classroom with students in learning activities.

Coding: The analytic processes through which data are fractured, conceptualized, and integrated to form theory (Strauss & Corbin, 1998, p. 3).

Concepts: The building blocks of theory (Strauss & Corbin, 1998, p. 101).

Concurrent Embedded Design: A mixed method design where the priority between quantitative and qualitative data "is usually unequal and given to one of the two forms of data—either to the quantitative or qualitative data. The nested, or embedded, forms of data are, in these designs, usually given less priority" (Hanson, Creswell, Plano-Clark, Petska, & Creswell, 2005, p. 229)

Culture: "The forms of traditional behavior which are characteristics of a given society, or of a group of societies, or of a certain race, or of a certain area, or of a certain period of time" (Mead, 1937, p. 17).

Digital Divide: Refers to any inequalities between groups, broadly construed, in terms of access to, use of, or knowledge of information and communication technologies (Wikipedia, 2011).

Digital Learning Technology: Digital applications that "encompasses a wide spectrum of tools and practice, including using online and formative assessment, increasing focus and quality of teaching resources and time, online content and courses, applications of technology in the classroom and school building, adaptive software for students with special needs, learning platforms, participating in professional communities of practice, providing access to high level and challenging content and instruction, and many other advancements that technology provides to teaching and learning" (Schwartzbeck, 2012, p. 1).

First Order Change: "Incremental change that fine-tunes the system through a series of small steps that do not depart radically from the past" (Marzano, Waters, & McNulty, 2005, p. 66).

High Order Skills: Those skills necessary to "analyze, synthesize and apply evidence"... critical thinking, communication, problem-solving, collaboration and reasoning (Chun, 2010).

Internet Service Provider: An Internet Service Provider is a company that provides access to the Internet.

Methodology: A way of thinking about and studying social reality (Strauss & Corbin, 1998, p. 3).

Methods: A set of procedures and techniques for gathering and analyzing data (Strauss & Corbin, 1998, p. 3).

Microblogging: A broadcast medium of a blog which allows users to exchange small elements of content such as short sentences, individual images, or video links (Kaplan & Haenlein, 2011).

Mixed Method Design: A mixed-methods evaluation is one that "establishes in advance a design that explicitly lays out a thoughtful, strategic integration of qualitative

Microblogging: A broadcast medium of a blog which allows users to exchange small elements of content such as short sentences, individual images, or video links (Kaplan & Haenlein, 2011).

Mixed Method Design: A mixed-methods evaluation is one that "establishes in advance a design that explicitly lays out a thoughtful, strategic integration of qualitative and quantitative methods to accomplish a critical purpose that either qualitative or quantitative methods alone could not" (Gargani, 2012, p. 1).

One to one: The ratio of computing device per end user, a tool per learner and teacher.

One to one laptop program definition for study: 1) students and teachers having access to laptops anytime, anywhere, in and out of school, 2) access to a wireless infrastructure, 3) the use of the laptops included in the curriculum as tools of learning, 4) a professional development model including technology integration in the learning process, and 5) a policy of at-home use of a school issued laptop at some time during the program.

Open coding: The analytic process through which concepts are identified and their properties and dimensions are discovered in data (Strauss & Corbin, 1998, p. 101).

Personal Use: The use of technology in personal life daily functions.

Photosharing: The publishing or transfer of a user's digital photos online to share publicly or privately with individuals

Professional Practice: The use of technology in the professional arena of teaching to include aspects of preparation, planning, administration, organization, assessment and professional development.

RSS - Really Simple Syndication: A family of web feed formats used to publish frequently updated works—such as blog entries, news headlines, audio, and video—in a standardized format enabling subscription (Libby, 1999).

Second Order Change: "Deep changes that alter the system in fundamental ways, offering a dramatic shift in direction and requiring new ways of thinking and acting" (Marzano et al., 2005, p. 66).

Social bookmarking: The use of a web site to mark resources found on the Internet by URL by adding metadata tags and sharing those bookmarks with others (LeFever, 2012).

Student-Centric Instruction: An approach to learning that places an emphasis on "changes in students' learning and on what students do to achieve this rather than on what the teacher does" (Harden & Crosby, 2000, p. 338) by giving "students greater autonomy and control over choice of subject matter, learning methods and pace of study" (Sparrow, Sparrow, & Swan, 2000, p. 1). Used synonymously with constructivist instruction in study.

Teacher-Centric Instruction: Focuses "on the teacher as a transmitter of information, with information passing from the expert teacher to the novice" (Harden & Crosby, 2000, p. 338).

Teaching Philosophies: "Written statements of why teachers do what they do—their beliefs and theories about teaching, about students and about learning, all of which underpin what and how they teach" (Fitzmaurice & Coughlin, 2007, p. 3). Used synonymously with beliefs in study.

Technology Integration: The application technology "to introduce, reinforce, extend, enrich, assess, and remediate student mastery of curricular targets" (Hamilton, 2007, p. 20).

Theory: A set of well-developed concepts related through statements of relationship, which together constitute an integrated framework that can be used to explain or predict phenomena (Strauss & Corbin, 1998, p. 15).

Twenty-First Century Skills: "The skills, knowledge and expertise students should master to succeed in work and life in the 21stcentury: core subjects and 21st century themes; learning and innovation skills; Information, media and technology skills and life and career skills" (Partnership for 21st Century Skills, 2011).

Videosharing: The publishing or transfer of a user's videos online to share publicly or privately with individuals.

Wiki: A website which allows its users to add, modify, or delete its content via a web browser using a simplified markup language or a rich-text editor (Encyclopedia Britannica, 2008).

Worldview: " A means of conceptualizing the principles and beliefs - including the epistemological and ontological underpinnings of those beliefs - which people have acquired to make sense of the world around them" (Kawagley, Norris-Tull, & Norris-Tull, 1998, p. 133).

Appendix C: IRB Approval

FAIRBANKS

Institutional Review Board

December 21, 2010

To:	John Monahan Principal Investigator
From:	University of Alaska Fairbanks IRB
Re:	[174781-2] Levels of Technology Use by Students and Teachers in K12 Alaskan 1:1 Laptop Learning Programs

Thank you for submitting the New Project referenced below. The submission was handled by Expedited Review under the requirements of 45 CFR 46.110, which identifies the categories of research eligible for expedited review.

Title:	Levels of Technology Use by Students and Teachers in K12 Alaskan 1:1 Laptop Learning Programs
Received:	December 6, 2010
Expedited Category:	7
Action:	APPROVED
Effective Date:	December 21, 2010
Expiration Date:	December 21, 2011

This action is included on the January 27, 2011 IRB Agenda.

No changes may be made to this project without the prior review and approval of the IRB. This includes, but is not limited to, changes in research scope, research tools, consent documents, personnel, or record storage location.